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INSTALLATION OF LARGE-SIZE TECHNOLOGICAL EQUIPMENT  
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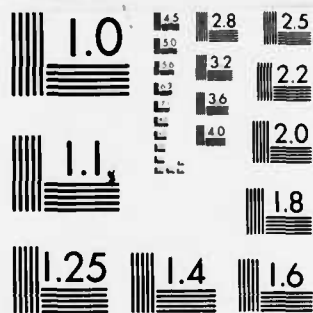
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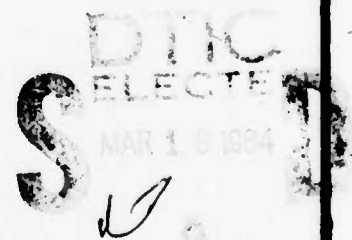
## FOREIGN TECHNOLOGY DIVISION



INSTALLATION OF LARGE-SIZE TECHNOLOGICAL EQUIPMENT  
(Selected Pages)

by

P.Ya. Golovashchenko



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INSTALLATION OF LARGE-SIZE TECHNOLOGICAL EQUIPMENT  
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PREPARED BY:

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FOREIGN TECHNOLOGY DIVISION  
WP-AFB, OHIO.

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# U. S. BOARD ON GEOGRAPHIC NAMES TRANSLITERATION SYSTEM

Block	Italic	Transliteration	Block	Italic	Transliteration
А а	<i>А а</i>	A, a	Р р	<i>Р р</i>	R, r
Б б	<i>Б б</i>	B, b	С с	<i>С с</i>	S, s
В в	<i>В в</i>	V, v	Т т	<i>Т т</i>	T, t
Г г	<i>Г г</i>	G, g	У у	<i>У у</i>	U, u
Д д	<i>Д д</i>	D, d	Ф ф	<i>Ф ф</i>	F, f
Е е	<i>Е е</i>	Ye, ye; E, e*	Х х	<i>Х х</i>	Kh, kh
Ж ж	<i>Ж ж</i>	Zh, zh	Ц ц	<i>Ц ц</i>	Ts, ts
З з	<i>З з</i>	Z, z	Ч ч	<i>Ч ч</i>	Ch, ch
И и	<i>И и</i>	I, i	Ш ш	<i>Ш ш</i>	Sh, sh
Й й	<i>Й й</i>	Y, y	Щ щ	<i>Щ щ</i>	Shch, shch
К к	<i>К к</i>	K, k	Ъ ъ	<i>Ъ ъ</i>	"
Л л	<i>Л л</i>	L, l	Ы ы	<i>Ы ы</i>	Y, y
М м	<i>М м</i>	M, m	Ь ь	<i>Ь ь</i>	'
Н н	<i>Н н</i>	N, n	Э э	<i>Э э</i>	E, e
О о	<i>О о</i>	O, o	Ю ю	<i>Ю ю</i>	Yu, yu
П п	<i>П п</i>	P, p	Я я	<i>Я я</i>	Ya, ya

\*ye initially, after vowels, and after ъ, ы; e elsewhere.  
When written as ë in Russian, transliterate as yë or ë.

## RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English	Russian	English	Russian	English
sin	sin	sh	sinh	arc sh	sinh <sup>-1</sup>
cos	cos	ch	cosh	arc ch	cosh <sup>-1</sup>
tg	tan	th	tanh	arc th	tanh <sup>-1</sup>
ctg	cot	cth	coth	arc cth	coth <sup>-1</sup>
sec	sec	sch	sech	arc sch	sech <sup>-1</sup>
cosec	csc	csch	csch	arc csch	csch <sup>-1</sup>

### Russian English

rot curl  
lg log

### GRAPHICS DISCLAIMER

All figures, graphics, tables, equations, etc. merged into this translation were extracted from the best quality copy available.

INSTALLATION OF LARGE-SIZE TECHNOLOGICAL EQUIPMENT.

P. Ya. Golovashchenko.

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INTRODUCTION

Directives of the XXIV Congress of CPSU for the five-year plan of the development of the national economy of the USSR during the years 1971-1975 provide for further development of our country.

The technical base of industry and rural economy radically is changed.

Primary task of the five-year plan - the guarantee of considerable raising of the material and cultural standard of living of people will be solved on the basis of the high tempos of the development of socialist production, increase in its effectiveness, scientific-technical progress and acceleration of a rise in productivity of labor/work.

The rapid development of the production capacities of socialist industry is accompanied by the implementation of new highly productive large-size technological equipment.

An increase in the power of each unit of large-size technological equipment requires increase in its quality, reliability and service life in the operation.

Experiment of building and putting into operation of important enterprises and productions shows that an improvement in the quality of the installation of large-size technological equipment and the guarantee of its reliability in the solution of general problem - of constructing rapidly, well and cheaply - in large measure depend on the timely and correct solutions of the complicated technical and organization questions, which appear during the planning, manufacture and transporting of large-size technological equipment, from connecting/fitting of construction and installation works on the objects, the observance of construction norms and rules, from the presence of reserves and guarantee of a front of works on the installation of technological equipment on the foundations.

The installation of large-size technological equipment is based

on the single principle - installation/setting up to the foundations of completely finished machines, mechanisms and apparatuses or their large/coarse completed, not requiring adjustment assembling units. Only the complete complete/unitized plant readiness of the large-size technological equipment, supplied by the Machine Building Plants, can guarantee the compressed periods of the building of the most important industrial complexes in all branches of national economy and the high quality of machines, mechanisms and apparatuses, provide their reliability and service life in the operation.

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An increase in the power and an improvement in other characteristics of erecting cranes in recent years expanded the technical capabilities of the installation of large-size technological equipment.

The elaborate complex of the engineering labor/work of many organizations, which participate in the building, is represented by examples from the practice of the installation of large-size technological equipment on the building of important enterprises and productions of number of the branches of industry.

In the book the many-year experience on the installation of

large-size technological equipment in the industrial centers of the country is reflected. Based on the examples of the installation of the large-size rolling mills of ferrous metallurgy, apparatuses of chemical production and rotary cement furnaces the achievements of Soviet and foreign mechanical engineers and erectors are shown.

The author with appreciation will take observations and wishes, which the readers according to this book will express.

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Chapter 1.

#### LARGE-SIZE TECHNOLOGICAL EQUIPMENT.

Machines and the mechanisms of ferrous metallurgy.

In the metallurgical industry almost all basic technological equipment - large-size. For yield and enrichment iron, manganese and other ores large-size stepping and rotor excavators, powerful crushers, tube rotating spherical and rod mills, conveyors and agglomerating facility are utilized in an open manner. During the mine/shaft development of ores large-size hoisting machines are applied.

In the blast furnaces for the melting from the ore of cast iron charging equipment (Fig. 1) is basic type of large-size technological equipment.

The ore yard of blast-furnace plant is serviced by powerful/thick self-propelled car dumper and crane-conveyors/reloaders.

In the steel foundry shops - converter and Martin - basic type of large-size technological equipment are the mixers for hot cast iron, converters (Fig. 2), pouring and pouring/casting bridge cranes, and also installations/settings up the continuous castings of steel.

In the rolling departments basic type of large-size technological equipment are the roll stands and shears of slabbing mills, blooming mills, procurement, rails-and-beams, laminated, large-size and other rolling mills (Fig. 3).

In the years of the five-year plans in our country was created the new branch of industry - metallurgical machine building.

Output by this branch was increased with 6.9 thousand t in 1932

to 320 thousand t 1969, i.e., 46 times. Are constructed the blast furnaces with a volume of 2700 and 3000 m<sup>3</sup> - largest/coarsest of the effective furnaces. In our country the progressive and very economical method of the continuous casting of steel is created. In the beginning 1971 in the metallurgical enterprises more than 30 installations/settings up of the continuous casting of steel acted.

The Novokramatorsk and old-Kramatorsk Heavy Machine Building Plants manufactured highly productive strip mill "2000". On it the slabs, poured on the installations/settings up of the continuous casting of steel, are rolled with a speed of up to 19 m.

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The Soviet converters, whose capacitance is two times more than affecting, are created by the Zhdanov Heavy Machine Building Plant.

For expanding the production of sheet steel for the passenger automobiles, the coolers, the canning tare and other metalware the collective of plant "Uralsmash [Уралмаш - Ural Heavy Machinery Plant im. Sergo Ordzhonikidze]" creates highly productive cold mills. The equipment of shop for the production of thin transformer steels here is manufactured. Their use makes it possible to improve quality and reliability of the produced electrical equipment, considerably

decreases the dimensions and the weight of transformers.

According to directives of the XXIV Congress of CPSU for the five-year plan of the development of the national economy of the USSR is planned a growth in the production capacities in ferrous metallurgy to accomplish/realize due to the building of the aggregates/units of large unit power, in particular, the blast furnaces with the volume of 5000 m<sup>3</sup>, oxygen converters with the weight of melting 350 t.

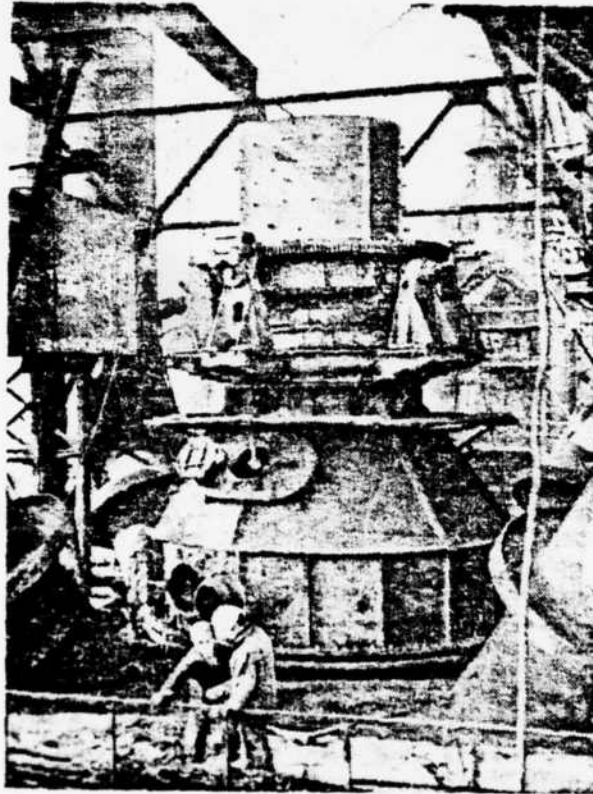


Fig. 1 charging equipment of blast furnace.

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Metallurgical machine building now has the capability to manufacture the aggregate/unit of any complexity in a year-two, not more. In order to more rapidly introduce new powers into the action, it is necessary with the manufacture of equipment to simultaneously lay for it foundations so that it would be possible to set to all

mechanisms in proportion to their entrance.

In the technological equipment of the enterprises of ferrous metallurgy the greatest specific gravity/weight compose the machines and the mechanisms of rolling departments.

The total weight of technological equipment of contemporary metallurgical enterprise of the tons, accepted as 100% (without the productions of yield and ore concentration), consists approximately/exemplarily of 51% of technological equipment of rolling departments, 17% of technological equipment of steel smelting ones and on 16% of technological equipment of dome-shaped and coke-chemical shops.

In the metallurgical enterprises, where the coke-chemical shop is isolated in the independent by-product plant, the specific gravity/weight of technological equipment of rolling departments composes 61%, steel smelting 20% and blast-furnace plant 19%.

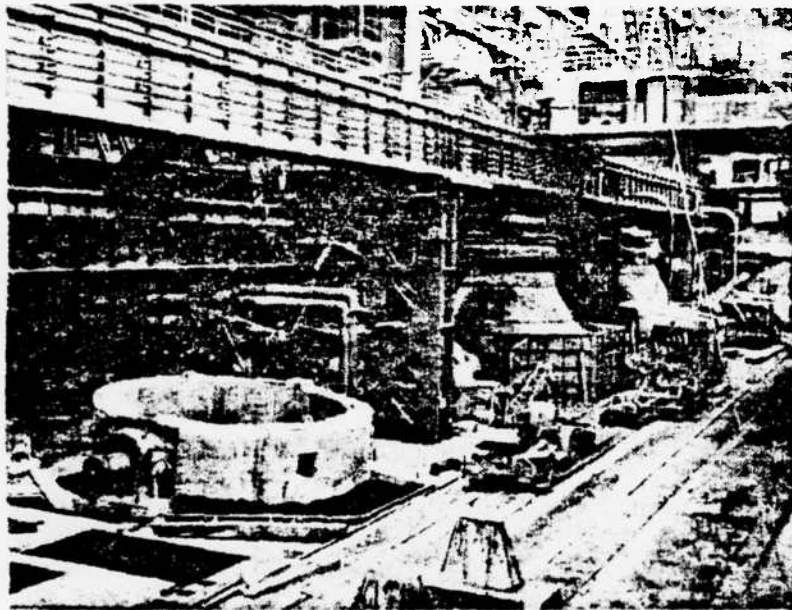


Fig. 2. Converter flight/span of the main housing of oxygen-converter shop.

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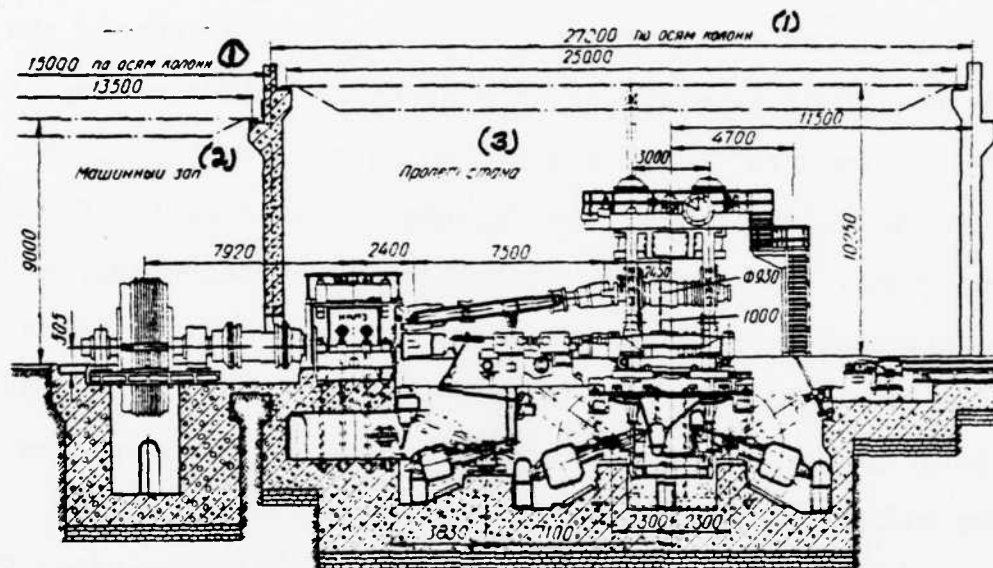


Fig. 3. The general view of the main line of blooming mill 1000 mm.

Key: (1). along the axes of columns. (2). machine room. (3). Span of mill.

Approximately/exemplarily in the dependence indicated are found capital investments and volumes of the construction-assembly works on the productions of metallurgical cycle indicated.

Steel of different profiles/airfoils and sizes/dimensions, which satisfies the needs of all branches of national economy, is the

production of ferrous metallurgy. Rolling is the latter/last stage of the production of metal at the metallurgical plant. In contrast to other branches of the metallurgical production - dome-shaped and steel smelting, whose development in essence is determined by the improvement of the physicochemical technological processes, the progress in the rolling production depends on the creation of new rolling equipment. The guarantee of continuity of technological process at all stages of metal working during the rolling is main trend in the development of rolling production, which can be realized only by the creation of the corresponding constructions/designs of the rolling mills, use/application of contemporary methods of controlling of electric drive and automation of all processes. The fulfillment of these measures contributes to an increase in the productivity of aggregates/units, to the decrease of the losses of metal and of operating costs, and also to the facilitation of working conditions.

From the first years of industrialization the installation of the rolling mills in USSR for specific gravity/weight, diversity, complexity of equipment and larger volume of mechano-assembling works was the powerful/thick smithy of training the highly skilled frames/personnel on the installation of technological equipment.

APPARATUSES OF CHEMISTRY.

V. I. Lenin emphasized that together with power engineering, machine building and metallurgy chemical industry is one of the bases of the creation of powerful/thick saving. Even in the plan/layout of GOELRO [State Commission for the Electrification of Russia], that marked the first landmarks on the way to the highly developed industry, large place it was diverted chemistry. With each five-year plan the scales of the building of chemical enterprises are expanded. Are improved old and appear new technological processes, the powers of the basic forms of technological aggregates/units grow, increase sizes/dimensions and weight of apparatuses.

In the chemical, the petrochemical, the coke-chemical, that refine oils, petroleum, gas, pulp and paper and in some other branches of industry column type welded steel apparatuses, horizontal and spherical forms are basic type of large-size technological equipment.

Column type contemporary welded apparatuses have sizes/dimensions on the height/altitude to 100 m, according to the diameter to 14 m. Are built up and are set in design position the apparatuses with a weight of up to 1000 t.

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Welded steel devices of a spherical form are made with a diameter of 40m.

Welded steel apparatuses depending on technological designation/purpose are characterized by construction/design, sizes/dimensions, complexity of internal devices, by the materials, from which are manufactured the housings and their internal devices, by anticorrosive and thermal protective coatings. Table 1 gives sizes/dimensions and weight of apparatuses for the production of sulfuric acid; in Table 2 - for the production of the gasoline and other commercial products from the crude oil; in Tables 3, 4 they are represented the characteristic of apparatuses for the boiling of the semi-finished product of sulfite pulp for obtaining of viscose and cord filament, and also basic component of paper and cardboard.

Table 1. Sizes/dimensions and the weight of column type apparatuses for the production of sulfuric acid.

(4) Аппарат	(2) Диаметр	(3) Высота	Вес, г (1)		
			(5) корпус	(6) внут-реннего устройства	(7) защит-ного покрытия
(8) Промывная башня	5,5	12,7	39	3	141
(9) Мокрый электрофильтр	4,6	11,6	17	22	90
(10) Сушильная башня	6	13,8	30	126	161
(11) Анидридный холодильник	4,2	13,5	18	75	2
(12) Олеумный абсорбер	6	14	30	151	160
(13) Моногидратный абсорбер	6	13,8	30	126	161
(14) Отдувочная башня	3,6	12,5	15	43	69
(15) Теплообменник	4,2	13,3	16	87	23
(16) Контактный аппарат	9	21,2	96	272	442

Key: (1). Weight, t. (2). Diameter. (3). Height/altitude. (4). Apparatus. (5). housing. (6). internal device. (7). protective coating. (8). The scrubber. (9). Wet electric filter. (10). The tower dryer. (11). Anhydrous cooler. (12). Oleum absorber. (13). Monohydric absorber. (14). Blowing tower. (15). Heat exchanger. (16). Catalytic gas recombiner.

Table 2. Sizes/dimensions and the weight of the steel housings of column type apparatuses for the production of gasoline.

(1) Марка аппарата	(2) Диаметр, м	(3) Высота, м	(4) Вес, г
K-1	4	27,7	77,8
K-2	5	46,3	198,1
K-4	2,6	28,7	41,3
K-7	3	41,3	69,2
K-8	5	46,2	147,1
K-10	2	43,4	59,6
K-16	2,4/2,8	40,7	64,5
K-13	6,4/8. 6/4,2	23,4	187,7
P-1	8,4	46,0	289,1
P-2	11		348,0
E-34/1	7	26,0	72,8

Note. The weight of the steel housings of apparatuses is given without the weight of brace conduits/manifolds, metal structures of areas/sites, refractory lining and insulation/isolation.

Key: (1). Brand/mark of apparatus. (2). Diameter, m. (3). height/altitude, m. (4). Weight, t.

Fig. 4 shows wet-type electric filter - one of the apparatuses for the production of sulfuric acid. It is intended for the fine purification of the gaseous products of the firing of pyrite and is established after the scrubber, the total weight of its 128.72 t. For the production of 360 thousand t per annum of sulfuric acid it is necessary to establish/install eight such electric filters.

Electric filter recovers the fog/mist 5-20%- sulfuric acid  $H_2SO_4$ , oxides of arsenic  $As_2O_3$ , and selenium  $SeO_2$ . Temperature of gas at the entry into electric filter of 20-45°C.

Table 3. Characteristic of boilers made of two-ply steel of the periodic boiling of cellulose.

(1) Показатели	(2) Поставщики								
	(3) Завод "Уралхиммаш", СССР				(4) Фирма "КМ", Швеция		(5) Фирма "Раума-Репола", Финляндия		(6) Фирма "Парсонс-Витмор", Англия
(7) Объем котла, м³	160	250	270	320	320	144	140	110	320
(8) Диаметр корпуса (внутренний), мм	5000	6000	6000	6000	6000	4108	4150	4000	6000
(9) Высота (расстояние между фланцами горловины), мм	12810	14400	15350	16780	16225	14475	14550	12260	17000
(10) Толщина стенки, мм	30	36	36	36	35	20—21	21—25	24	34
(11) Толщина пержающего слоя, мм	5	5	5	5	5	5	5	5	5
(12) Рабочее давление, кг/см²	12	12	12	12	12	12	12	12	12
(13) Вес корпуса, т	20	63,3	68,8	83,5	91,6	38,5	38	35,6	92,2
(14) Количество поставляемых заводом блоков	14	14	14	16	(15) Поставляются в цельнообранном готовом виде				

Key: (1). Suppliers. (2). Indices. (3). Plant "Uralkhimash [Уралхиммаш - Ural Heavy Chemical Machinery Plant]", USSR. (4). firm "KM", Sweden. (5). firm "Rauma-Repola", Finland. (6). firm "Parsons-Vitemor", England. (7). Volume of boiler, m³. (8). Diameter of housing (internal), mm. (9). Height/altitude (distances between flanges of neck/throat), mm. (10). Thickness of wall mm. (11). They are supplied in fully assembled finished form. (12). Thickness of rustproof layer, m. (13). Working pressure, kgf/cm². (14). Weight of housing, t. (15). Number of units supplied by plant.

Table 4. Characteristic of the digesters of the continuous boiling of cellulose.

(2) Показатели	(1) Производительность установки, т./сутки			
	300	450	500	550
Объем аппарата, м <sup>3</sup>	350	375	460	620
Диаметр корпуса, мм:				
(5) верхней части	3800	3800	3500	5300
(6) средней	3950	3950	4570	5440
(7) нижней	4100	4100	4700	5720
Высота, мм	27000	32000	33000	56000
Толщина стенки, мм	25	30	32	36
Толщина нержавеющей слоя, мм	5	5	5	5
Рабочее давление, кг/см <sup>2</sup>	12	12	12	12
Вес корпуса, т	91	160	180	270

Key: (1). Productivity of installation/setting up, tons/day. (2). Indices. (3). Volume of apparatus, m<sup>3</sup>. (4). Diameter of housing, mm: (5). upper part. (6). the middle part. (7). lower part. (8). height/altitude, mm. (9). Thickness of wall, mm. (10). Thickness of the noncorrosive layer, mm. (11). Operating pressure, kgf/cm<sup>2</sup>. (12). Case weight, t.

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The housing of electric filter is made from sheet steel with a thickness of 8 mm, connected by continuous welded tight seam. The bottom of electric filter is simultaneously the carrying plate/slab, made from sheet steel with a thickness of 10 mm, to which the supporting beams from the steel double T are welded. Housing and bottom within the electric filter is tightly covered with the sheet lead with a thickness of 4 mm. The cover/cap of electric filter is made from sheet steel with the dense coating with lead, soldered on

by homogeneous method.

The refractory lining of electric filter is made from the acid-resistant brick, tightly connected by andesite mastic. In bricklaying are two steps: lower for the support of the grate from the timbers, which evenly distributes gas flow over entire section/cut of inlet chamber; upper - for the support of the grate of the unit of precipitating electrodes. The unit of precipitating electrodes consists of the grate, manufactured from the strip steel with a width of 140 and with a thickness of 10 mm, tightly covered with lead, soldered on by homogeneous method, and 183 precipitating electrodes from the sheet lead with a thickness of 3 mm, with effective length of 3350 mm, made in the form of hexangular section/cut with a diameter of the circumscribed circle of 250 mm, which form grate like bee hundred.

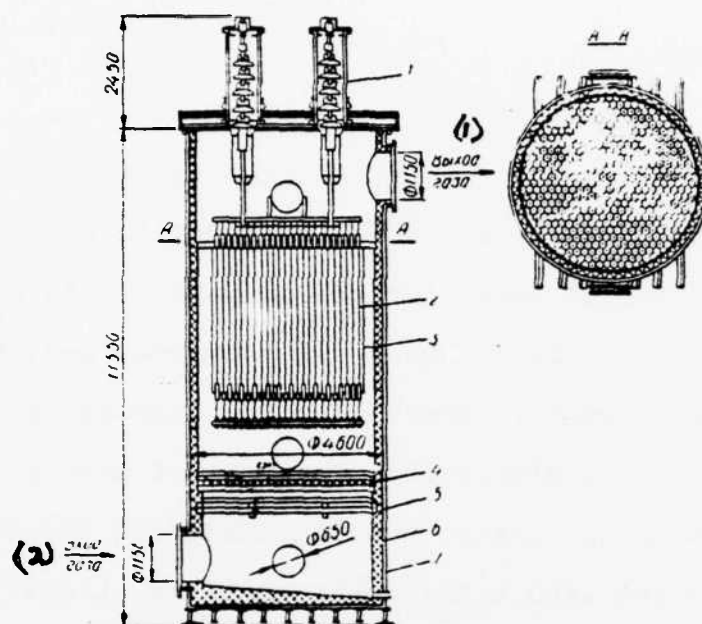


Fig. 4. Wet type electric filter MMK-9.6: 1 - chamber/camera of power supply; 2 - corona electrodes; 3 - precipitating electrodes; 4 - grate; 5 - refractory lining of housing; 6 - lead-lined coating of housing; 7 - housing of electric filter.

Key: (1) Outlet of gas. (2) Input of Gas.

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The surface of the cross section of precipitating electrodes is 9.6 m<sup>2</sup>. The finished block of the system of the precipitating electrodes before the dropping into the housing of electric filter is shown in Fig. 5.

The unit of corona electrodes consists of frame construction of the suspension of electrodes, strictly electrodes, tension weights and distance saddles. The frame of the suspension of electrodes is made from steel double T and ducts/tubes/pipes, tightly covered with lead, soldered on by homogeneous method, it is suspended/hung with the aid of four rods/thrusts and insulators to the cover/cap of electric filter. From this frame 183 corona electrodes are suspended/hung. By the carrier of electrodes is the steel wire the diameter of 1.8 mm, covered with lead with the cross section in the form of hexangular star with a diameter of the circumscribed circle of 12 mm.

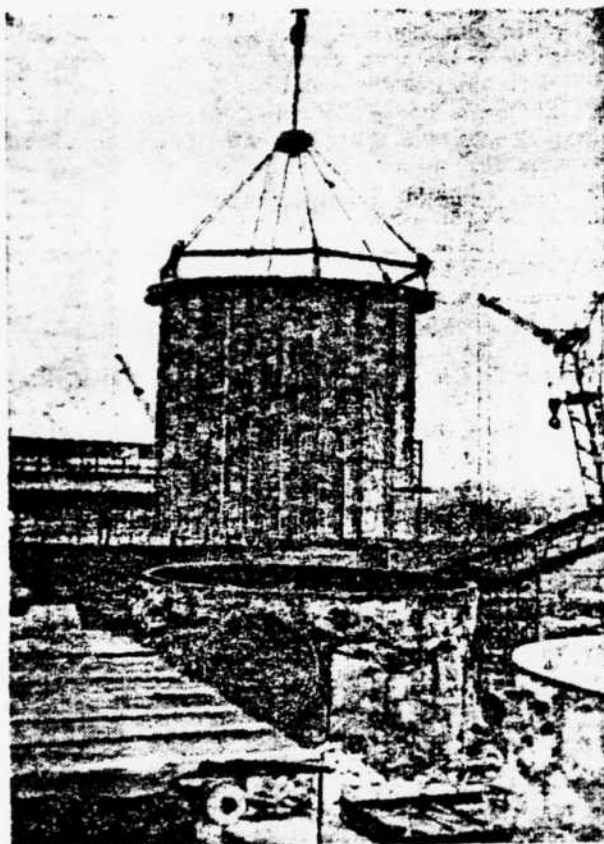


Fig. 5. Finished unit of the system of the lead precipitating electrodes of wet type electric filter ИМК-9.6.

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Fig. 6 shows reactor-regenerator of the combined installation/setting up for the production of the gasoline and other products from the petroleum.

Reactor vessel is made from sheet steel with a thickness of 18 and 22 mm, the housing of regenerator - made of sheet steel with a thickness of 16 and 22 mm, connected by continuous welded tight seam. The operating conditions of the apparatuses indicated are given in Table 5. The internal surface of housings after their pressure test by the compressed air is thoroughly cleaned with shotblasting apparatus under the refractory lining. Refractory lining is made by heat-resistant concrete by the method of guniting. The thickness of gunite-concrete is 200 mm. Thermal insulation and armored layers of gunite-concrete will be applied on by the thoroughly purified and prepared corresponding method the surface of steel housings in a strict sequence, thoroughly checking the quality of the materials used and accomplishing working operations, including the hydrothermal treatment of each layer. The refractory lining of steel housings by gunite-concrete is one of the most critical/heaviest-duty processes, which ensure the normal operation of apparatuses, and is produced at a temperature not lower than 5 and not higher than 25°C. Therefore it is very important to make the refractory lining of apparatuses in the warm period of year, without the device of special over-all housings for the heating.

Table 5. The operating conditions of reactor and regenerator of the combined installation/setting up for petroleum refining.

(2) Показатели	(3) Реактор	(1) Регенератор	
		(4) в корпусе	(5) в змеевике
(6) Давление в нижней части, атм	1,2	0,6	23,5
(7) Давление в верхней части, атм	0,9	0,3	23,5
(8) Давление сжатым воздухом при испытании, после заполнения аппарата катализатором до уровня, соответствующего 350 т загрузки, атм	2	(9) 1,6	29
(9) Температура, град С	490	600 в кипящем слое (10) 150 под нижней решеткой (11) Дымовые газы. Воздух (12)	230-450
(12) Среда	(13) Микросферический алюмосиликатный катализатор. Нефтяные пары, содержащие около 2,2% сернистых соединений. Водяной пар	(14) Пар	(15) Пар
(17) Эрозия	(18) Сильная	(18) Сильная	

Key: (1). Regenerator. (2). Indices. (3). Reactor. (4). In the housing. (5). in the coil. (6). Pressure in lower part, atm(gage). (7). Pressure in upper part, atm(gage). (8). Pressure by the compressed air during the testing, after the filling of apparatus with catalyst to the level, which corresponds to 350 t load, atm(gage). (9). Temperature, deg C. (10). in the fluidized bed. (11). under the lower grate. (12). Medium. (13). Micro-spherical aluminosilicate catalyst. Petroleum vapors, which contain about 2.2% of sulfides. Water vapor. (14). Flue gases. (15). Vapor. (16). Air. (17). Erosion. (18). Strong.

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In recent decade for manufacturing the chemical apparatus two-ply steel found wide application, in which the inner layer, which is contacted with the aggressive medium, is made made of high-alloyed austenitic steel, and an outer layer - made of the carbon steel or low-alloy steel.

Bimetallic apparatuses have a series/row of advantages over apparatuses with the ceramic refractory lining. With the identical dimensions the volume of bimetallic apparatuses to 10-15% is more than lined and the service life of corrosion-resistant steel of austenitic structure is more than ceramic refractory lining

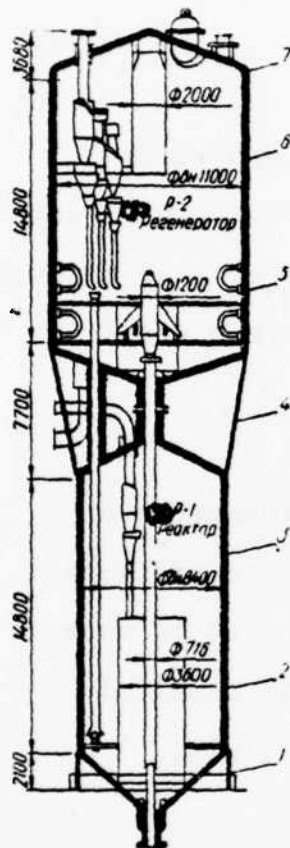


Fig. 6.

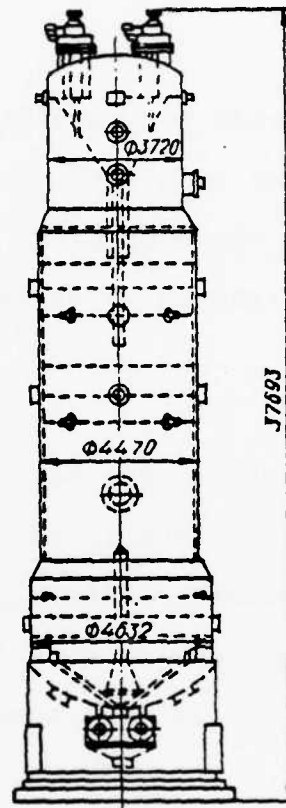


Fig. 7.

Fig. 6. The assembling units of reactor-regenerator of the combined installation/setting up for petroleum refining: 1 - carrier ring with a weight of 16 t; 2 - lower half of the reactor with a weight of 105 t; 3 - upper half of the reactor with a weight of 107 t; 4 - transfer conical shell with the weight of 60 t; 5 - lower part of the regenerator with the weight of 158 t; 6 - the middle part of the

regenerator with the weight of 50 t; 7 - upper part of the regenerator with the external metal structures with the weight of 96 t.

Key: (1). Regenerator. (3). Reactor.

Fig. 7. Apparatus for the continuous boiling of cellulose.

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Sharp drops/jumps in the pressure and temperature cause strain and damages of ceramic refractory lining, but bimetallic apparatuses are not sensitive to this. The damages of refractory lining do not yield to visual observation, which frequently leads to a deep corrosion of housing, and also, therefore, to the prolonged repair. Apparatuses made of two-ply steel provide the purity/finish of contents, the corrosion of housing it is easy to reveal/detect with the inspection, it it is possible to remove via auxiliary welding. The normal operation of apparatuses large-size according to the diameter made of two-ply steel in many respects depends on the correct organization of the technological process of assembly and welding of apparatuses from the separate elements/cells. Therefore special importance has the delivery of apparatuses by the Machine Building Plants in completely assembled finished form.

Apparatuses for the continuous boiling of cellulose have

essential structural differences from the digesters of periodic action. At present the widest use obtained two basic types of these apparatuses: multitube with horizontal run of pipes and transportation worm conveyor within each of duct/tube/pipe and the vertically established/installed cylindrical apparatuses (Fig. 7) with the charging and unloading devices.

#### ROTARY FURNACES OF CEMENT WORKS.

In the industry of building materials, in the chemical, the aluminum, the metallurgical and in other branches of industry are extensively used the welded steel rotary furnaces, desiccators, coolers, crystallizers and other apparatuses with rotating large-size drums, intended for the thermal, chemical and combined treatment of different materials.

Most complicated of them are the main technological aggregates/units of cement works - eight-support rotary furnaces (Fig. 8).

The contemporary standard cement works, which has four rotary furnaces with the size/dimension  $5 \times 185$  of m with the general/common/total design productivity of 2.4 mln. t of cement per annum, manufactures cement more than 50 fine/small plants of Russia,

which released in 1913 only 1.7 mln. t.

The rotary furnace (Fig. 9) is the slowly rotating drum made of sheet steel, lined by the refractory brick, into charging part of which the sludge is supplied. From the side of unloading - this part of the furnace is called head - through the injectors it is blasted the fuel/propellant - dustlike, liquid or gaseous. Sludge moves towards the head of furnace, and towards it move flue gas, from the contact with which the sludge is dried out and is annealed/scorched. For an improvement in the heat exchange between the gases and the material in the cold part of the furnace is made the curtain from the physical circuits, which are fastened to inside of housing.

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In the process of the firing of raw mixture oxide of calcium  $\text{CaO}$ , entering the composition of chalk or limestone, and chemical compounds, available in the clay ( $\text{SiO}_2$ ,  $\text{Al}_2\text{O}_3$ , etc.), interact between themselves, as a result at a temperature about  $1450^\circ\text{C}$  is formed the clinker - granule of greenish color by size/dimension with pea.

From the furnace through the transfer chamber/camera and the coolers the cooled clinker enters tube ball mills, where it is ground

with the necessary additives. Powder obtained in this case is cement.

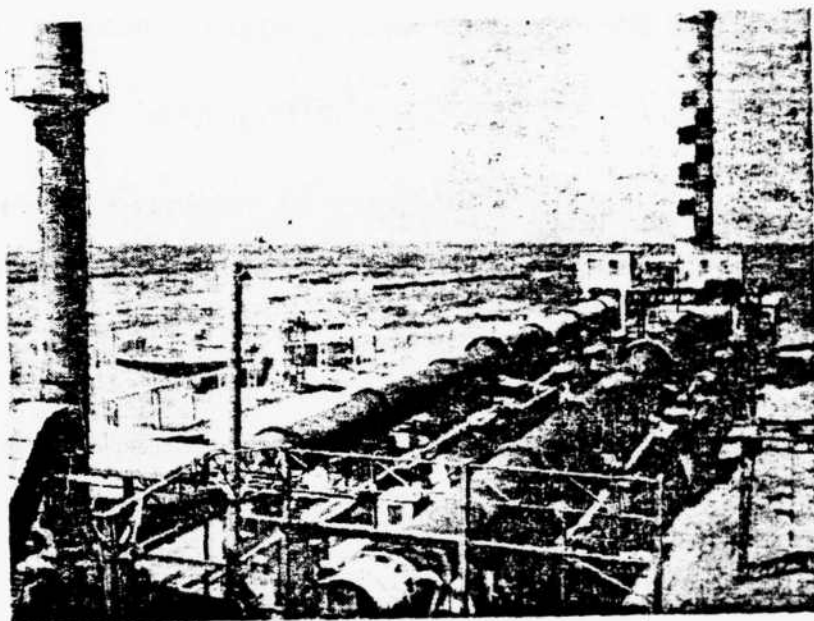


Fig. 8. Rotary furnaces with a diameter of 5 and with a length of 185 m.

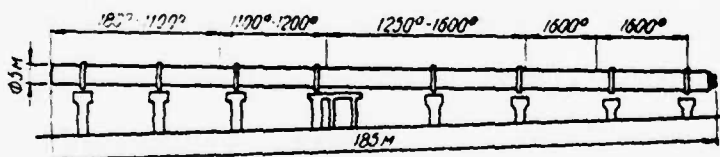


Fig. 9. Temperature zones in the furnace.

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At the Balakleyskiy cement works unique fifth technological line with the rotary furnace with a diameter of 7 m, with a length of 230 m and with the weight of equipment without the refractory lining 6500

t is installed. One such furnace will produce 1 mln. t of clinker per annum.

In the cement industry a quantity of produced cement and its property they are connected with the process of the firing of raw mixture.

Shaft batch furnaces were the first furnaces, which were being applied for the firing; their productivity was very low: from 3 to 7 t/h.

Them replaced the rotary furnaces of continuous action with the housing made of sheet steel with the riveted connection with a length of up to 60 m and with a diameter of up to 3 m. The peak output of such furnaces was approximately 12 t/h. After the Great Patriotic War, when an enormous quantity of cement for restoring the national economy was required, most powerful (for those times) rotary furnaces with a length of 150 m, with a diameter of 3.6 m, with a productivity of 25 t/h found wide application.

In recent years new, even more powerful/thicker rotary furnaces were created. The rotary furnaces with a diameter of 4.5 and with the length of 170 m, furnaces with a diameter of 5 and with a length of 185 m were created; the furnace with a diameter of 7 and with a

length of 230 m at present is installed. Their design productivity compose with respect 50, 75 and 125 t/h. The productivity of powerful/thick furnaces is 2-5 times higher than 150-meter ones; specific capital expenditures for 1 t of power during the building of such furnaces are 15-20% lower, and the prime cost of the firing of clinker to 9-12% is less. The created furnaces are some of the powerful/thick ones in the world.

During the creation of furnace-giants there were numerous difficulties, one of them was connected with the method of the delivery/procurement of furnaces from the manufacturing plant to the site of installation.

Railroad bridges, overbridges make it possible to transport loads with the height/altitude not more than 4 m. Foreign firms transport cement large-diameter kilns by large/coarse assembling units on special conveying appliances along the highways and by waterways.

In the Soviet Union furnace-giants at the plants are made in the form of semirings or segments for the transportation by railroad.

Part-semi-finished products of the housings of the rotary furnaces deliver to construction site and here are carried out

consolidation assembly and their welding into the assembling units.

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#### TECHNOLOGICAL BASES OF MANUFACTURE AND INSTALLATION.

In the contemporary sense technology - studies about the processes of the treatment of materials, the manufacture of them of parts and the assembly of them of finished articles. Parts are those machined in accordance with the working drawing: the laminated element/cell of the shell of vessel or apparatus; the cut/section of beam/gully, channel bar, angle, band or another form of the rolled metal. The sum of the parts, assembled by any form of connection according to assembly drawing - by welding, by riveting, soldering, by bolts, etc. into the structural/design part of the apparatus, machine, is called unit. The sum of the units, assembled by any forms of connection according to assembly drawing into the larger/coarser structural/design part of the apparatus, machines, are called unit. Control assembly, adjustment and bench tests of units, units and as a whole of apparatus, machine and the like create the end product of production - article.

Article is the object/subject of the delivery of equipment for the building.

The contemporary installation of large-size technological equipment during the guarantee of normal, i.e., complete/unitized and good-quality delivery of articles with the plants of machine building, is the technological process only of the assembly of units, assemblies and completing parts, accomplishing of the forms of connection and testing in accordance with erection drawings and commands of the supplier plants of equipment, but without accomplishing of any adjustable operations or any finish manufacture of units, assemblies and parts.

In cases when fundamental positions about the readiness of article are disturbed, to the technological process of assembling assembly forced are added the diverse operations of adjustment, treatment and assembly of units, assemblies and parts.

Technology of installation works as the process of assembly is divided into two basic stages: to the assembly of units, assemblies and parts, manufactured with supplier plant, into the larger/coarser assembling units in the limits of the use of maximum load capacity of available erecting cranes, and to lift and installation/setting up of assembling units to the design position on the foundation bases/roots.

Finished article for the first stage are assembling unit, the second stage - apparatus, machine, assembly of conduits/manifolds and the like depending on the accepted by the object technical division into loose parts of the general/common/total installation/setting up of equipment and its technological communications.

The guarantee of the most advantageous technical and economic indices, which in the final analysis lead to the smallest duration of the process of assembling assembly with the smallest labor cost, is primary task of the technological process of assembling assembly. The essence of contemporary technology of installation works consists in the rational enlarged assembly of units, assemblies and completing parts, manufactured with the supplier plant of equipment, into the assembling units and the rational methods of lift and installation/setting up of assembling units to the design position for the creation of the end product of installation - finished apparatus, of aggregate/unit, machine, mechanism and of their transmission for the adjustment and bringing into service.

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In the cases of the need for accomplishing during the building

in the process of the consolidation assembling assembly of the operations of finish manufacture of units, assemblies and parts the installation, besides two basic stages, includes three additional groups of the operations: lifting-transporting, adjusting and assembly.

The operations of latter/last group include all forms of connections, produced in the process of the assembly: welding, riveting, rolling, soldering, bolt and so forth, etc. As experiment of installation works is shown, most labor-consuming are the first two groups of the operations: lifting-transporting and adjusting. A number of adjusting operations includes, for example, the bending under, trimming and trimming of the edges of laminated elements/cells, shells and units of the housing of apparatuses; the trimming of the ends of the ducts/tubes/pipes before their installation/setting up for the rolling; cutting, trimming and the trimming of the ends of unpassivating different elements/cells and parts with their unit or block assembly; drilling holes and their thread and the like. The large part of similar operations relates not to technology of the assembly of finished articles, but to technology of the treatment of parts it is produced on the fitting bay forced as the elimination of the imperfections of supplier plants. With the decrease of adjusting works are reduced the lifting-transporting works, connected with the fitting, i.e., is reduced a quantity of the

most labor-consuming operations and, consequently, also a duration of the process of assembly; also descends its general/common/total labor consumption. Thus, basic technical delivery specifications of large-size technological equipment they must be: the high quality of the manufacture of machines, mechanisms and apparatuses, their control assembly under the plant conditions; the high degree of the completeness of all units, assemblies and parts, the eliminating need for adjusting works on the fitting bay, and also the equipment to be supplied, which eliminates the need for finish manufacture any parts of equipment or acquisition of special materials.

The selection of the version of the technological process of production on the manufacturing plant and on the equipment installation depends on the series/row of conditions. In machine-building production one of the conditions is the volume of production, caused by production program.

Depending on the volumes of production technology of machine building determines three basic types of the productions: individual, series and mass.

Piecework - this is the production, during organization of which the production program of the production of finished articles is characterized by the nonrecurrence of issue, by the diversity of

nomenclature and by the inconstancy of the circuit of technological operations. The diversity of parts and assemblies, which pass processing or assembly is the most characteristic feature of a similar organization of industrial enterprise. By the technological signs/criteria of piecework it is necessary to consider accomplishing all operations of assembly at one stationary work area the coordinated crews of the qualified fitters.

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Series production is characterized by the repeated, rhythmic production of the uniform batches of the finished articles of constant nomenclature. Series production is divided into the the large/coarse and the small-scale. With the great variety of nomenclature and the insignificant production of the batches of finished articles the production will relate to the small-scale type. Otherwise, i.e., with the small nomenclature of finished articles and the more or less considerable production of the batch of finished articles, production relates to the large-scale. Small-scale production gravitates to the piecework, and large-scale - to the mass.

Mass production assumes the continuous process of the manufacture of the prescribed/assigned article in a considerable

quantity. Constant accomplishing at each work area for one and the same continuously repeated operation is the main sign/criterion of the technological character of this production. Continuity the relative rhythmicity of the constant motion of parts and assemblies creates the continuity of the fulfilled technological process; therefore mass production is called assembly-line production. For the mass production characteristic features are maximum mechanization of manual labor, low qualification of production workers and wide interchangeability of parts and assemblies.

The installation of the large-size technological equipment for contemporary large/coarse productions is complex system; therefore the creation of the ordered flow chart of the carrying out of installation works is important task. For its solution, and also for convenience in the technological planning and simplification in the diagram of the organization of the carrying out of works it is necessary that all the equipment, which is subject to installation, would be concentrated in the separate unsubdivided sections of works. In the practice of installation the complex of equipment, which ensures the normal operation of the being put in operation large/coarse production capacity in the assembled form, is subdivided into the objects. For example, the complex of the equipment of the starting power of the large/coarse production of sulfuric acid is subdivided into: furnace department/separation; washing

department/separation; drying-absorption department/separation; contact-compressor department/separation; the installation/setting up of the catching of tail gases; the storages of pyrite; the pier of the retraction of cinders; galleries and the overload units of transporters; the piers of technological conduits/manifolds and station of neutralization. The exemplary/approximate volume of the basic mechano-assembling works, made with the erection of the objects of this production, is given in Table 6. In technology of installation works the object as the part of the installed complete/unitized equipment of the created production capacity is finished article.

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Thus, during the design of the technological process of the installation of the complete/unitized equipment of production capacity for the purpose of the best organization of the carrying out of works, on the basis of the special features/peculiarities of the separate types of equipment, which compose the set of production, should be developed/processed the technological processes of the installation of separate objects.

Contemporary technology of the installation of large-size technological equipment is accomplished/realized by two methods of

the carrying out of the works: individual assembly, or assembly, by "scattering", and large block assembly. By the characteristic feature of the installation of large-size technological equipment the method of individual assembly is the pronounced sequence of the assembling assembly of units, assemblies and parts, manufactured by plant-supplier, it is direct on the foundations, after construction and their inspection/acceptance under the equipment installation.

The characteristic feature of the installation of large-size technological equipment the method of large block assembly is the preliminary consolidation assembly of units, assemblies and parts, placed by manufacturing plant, into the larger/coarser assembling units out of the foundations, independent of the degree of their readiness. The selection of the method of installation in each specific case is determined by economic advisability.

The method of large block assembly assumes the decrease of number of labor-consuming works at the height/altitude and facilitation thereby of the labor/work of erector-steeplejacks; the decrease of the necessity for the scaffoldings, the temporary/time supports and the fastenings, the maximum coincidence of installation works on equipment with the carrying out of the construction work on the construction of foundations under the equipment and of other general-construction works of zero cycle, and also an increase in the

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safety of works on the installation of large-size technological equipment.

Table 6. Exemplary/approximate volume of installation works on the objects of the production of sulfuric acid.

(2) Объекты	(1) Объем монтажа, т		
	(3) Оборудование	(4) конструкции	(5) трубопроводы
(6) Гараж для размораживания колчедана	112	26	96
(7) Приемное устройство	96	11	8
(8) Открытый склад колчедана	600	—	—
(9) То же, закрытый	465	34	28
(10) Установка для уборки огарка	562	23	34
(11) Отделения:			
(12) печное	2288	61	484
(13) промывное	745	12	238
(14) сушильно-абсорбционное	1712	31	391
(15) контактно-компрессорное	1324	43	272
(16) Установка для улавливания хвостовых газов	210	12	89
(17) Склад серной кислоты	108	11	34

Key: (1). Volume of installation, t. (2). Objects. (3). equipment. (4). constructions/designs. (5). conduits/manifolds. (6). Garage for the thawing out of pyrite. (7). Receiver. (8). Open storage of pyrite. (9). The same, closed. (10). Installation/setting up for the retraction of cinder. (11). Departments/separations. (12). furnace. (13). washing. (14). drying-absorption. (15). contact-compressor. (16). Installation/setting up for the catching of tail gases. (17). Storage of sulfuric acid.

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The use/application of a method of large block assembling makes it possible to widely conduct enlarged preassembly assembly of the assembling units simultaneously of many apparatuses, machines, mechanisms, conduits/manifolds. The preliminary articulation of equipment to the large/coarse assembling units during the development of the construction/design of large-size apparatus, machine, mechanism contributes to this.

The preliminary articulation of equipment to the large/coarse assembling units frequently is determined during the development of the design of the carrying out of works by the specialized assembling organization. In this case in the large/coarse assembling units of equipment are included the operating metallic areas/sites, conduits/manifolds, thermal insulation, by acid- and refractory protection, with the transference of the main mass of assembly and special works on the pads beyond the limits of foundations under the equipment and the buildings, in which installation works must be fulfilled. Beyond the limits of building it is possible to perform the parallel assembly of many large/coarse assembling units from the

different parts of the complete/unitized large-size technological equipment, what is the first and basic difference from method of individual assembly.

Assembling organization and supplier plant produce consolidation works on the assembly of assembling units, construction organizations erect foundations under the building and equipment, is fulfilled zero cycle with the construction of basements, tunnels, channels. The simultaneously specialized assembling organizations lay technological ones and electrically communication. General contractual construction organizations obtain the technical capability to normally complete zero cycle by reverse/inverse filling of soil with the device of black/ferrous floors/sides and to put large/coarse industrial object under the installation of technological equipment without the repeated opening of soil and carrying out of subsequently any works of zero cycle.

Because of coarsening/consolidation of assembling units a quantity of separate fine/small units, assemblies and parts, manufactured with supplier plant and adjusted to the foundations in the individual order sharply is decreased. Thus is created the organized recurrence of production operations in the basic section of works - on installation on the foundation bases/roots of the preassembled large/coarse assembling units. The organized recurrence

of large-scale installation operations of assembling units is a sign/criterion of the large-scale type of production.

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The major advantages of the large block assembly over the method of the individual assembly by "scattering" it consists of the following:

the method of large block assembly allows in parallel to conduct installation works on all large-size apparatuses, machines, mechanisms already in the initial period of the building of units;

the assembly of large/coarse assembling units will be carried beyond the limits of the foundation of apparatus, machine, mechanism and even beyond the limits of the building, where they are established/installed. Thus, has the capability to conduct construction work according to the foundations of building and equipment simultaneously with the assembly of assembling units, which contributes to shortening the total time, required for the building of industrial unit;

the carrying out of fitters work on the large open pads allows/assumes wide and rational mechanization of

lifting-transporting works with the use of different self-propelled and other special taps/cranes, rail and tractor transport;

the assembly of separate relative to fine/small units, assemblies and parts of installations, apparatuses, machines and mechanisms with the aid of the taps/cranes on spacious assembly floors approaches the labor/work of erectors conditions of plant, shop assembly, that raises the productivity of labor/work;

the installation/setting up of the large/coarse finished assembling units of large-size technological equipment on foundations opens a wide front of works on the installation of auxiliary equipment, conduits/manifolds, constructions/designs and the carrying out of special construction work;

amount of work for assemblers-steeple jacks considerably is decreased, thanks to which the labor consumption of installation works is decreased, working conditions and safety of the carrying out of works are improved;

on assembly floors it is possible to fulfill acid-resistant, refractory, thermal and other types of protective coatings - before the installation/setting up of large/coarse assembling units to the foundations;

are decreased the volumes of works on the device of forests/scaffolding and intermediate temporary/time supports and unfastenings, since the large part of the works from the high-altitude marks is transferred down, to assembly floors and, furthermore, with the first large/coarse assembling units rise the constant staircases and the areas/sites, which from the first days of the installation of the large-size installations of apparatuses, machines and mechanisms are utilized for other installation and special construction work.

As a result of implementing the large block assembly the duration of the installation of large-size technological equipment and entire building of unit considerably is shortened.

The improvement of the method of large block assembly created the new form of the organization of the carrying out of installation works, named flow installation.

Such organization of installation, during which strictly is observed productive rhythm, established/installed by the graph of the carrying out of works, comprised for the assembly of assembling units and their installation/setting up in the design place with the

necessary continuity of the production process of assembly and installation/setting up, is called the assembly-line production of installation works.

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The methods of flow installation shift installation works from the primary form of their organization - the individual type of production - into the highest stage of technical organization - assembly-line production. Is most the rationally flow methods of the carrying out of works must be used during the simultaneous installation of several same-type large-size installations/settings up, apparatuses, machines and mechanisms with the displacement of the separate moments/torques of the carrying out of the works, adjusted by the technological sequence of installation on the graph.

In the basis of graphing of the flow installation of the technological equipment, technologically conduits/manifolds and constructions/designs is located the principle of the brigade distribution of working composition and the prescribed/assigned space of flow.

The strictness of the technological sequence of the carrying out of works makes it possible to organize the specialized working crews

of constant composition, occupied on the repeating works for the duration of entire duration of enlarged assembly and installation. By a similar organization the high quality of the made works and their successful accomplishing within the prescribed/assigned periods are achieved.

The space of flow is determined by the interval of time, during which the specialized working crew must fulfill the prescribed/assigned complex of works. The value of this interval of time is the constant, multiple for all specialized working crews, occupied on the works on the graph of the flow installation of technological equipment, technological conduits/manifolds and constructions/designs. The value of the space of flow with the labor intensity accepted determines number of required work force. An increase in the space of flow decreases the number of required work force, necessary for the production of the prescribed/assigned complex of assembly and mounting works, and, on the contrary, the decrease of the space of flow increases number of work force, necessary for the carrying out of these works.

#### TECHNICAL SPECIFICATIONS AND PRICE LISTS TO THE DELIVERY.

The machine-building manufacturing plants of large-sized technological equipment are obligated to supply it according to

technical specifications.

The price lists of wholesale prices of the production of machine-building plants are developed/processed and they are confirmed on basis of technical specifications.

Technical specifications to the delivery of large-size technological equipment are usually composite/compound component part of the technical specifications to the type of equipment independent of sizes/dimensions. Technical specifications are based on the requirements for the high quality of the produced articles, their completed technical readiness. Technical equipment and organization of the production of the contemporary specialized Machine Building Plants provide the observance of basic requirements for the articles of industry.

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Let us examine requirements for the delivery of large-size welded steel vessels and apparatuses in accordance with the inter-republican technical specifications MRTU 2-04-10-63, which affect from first January of 1964, and also by price list No 23-03 (Part II) to this type of equipment, put into operation from first July 1967.

According to MRTU 2-04-10-63 overall vessels and apparatuses are delivered in the assembled, finished form; large-size (outsize) apparatuses are delivered both in assembled, finished form and by units in accordance with the indications of working drawings or technical project. Term "standard size" and the "size limitation" of vessels and apparatuses is examined in MRTU in connection with the requirements of rail transport (Fig. 10).

In accordance with MRTU the vessels and apparatuses overall according to the diameter, but along the length not fitting themselves within the permissible (according to the rules of the Ministry of Railroads) dimensions of rolling stock with their dispatch by railroad, are delivered by the parts of a maximally transportable length with the guarantee if necessary for rigidity for the period of the transportation.

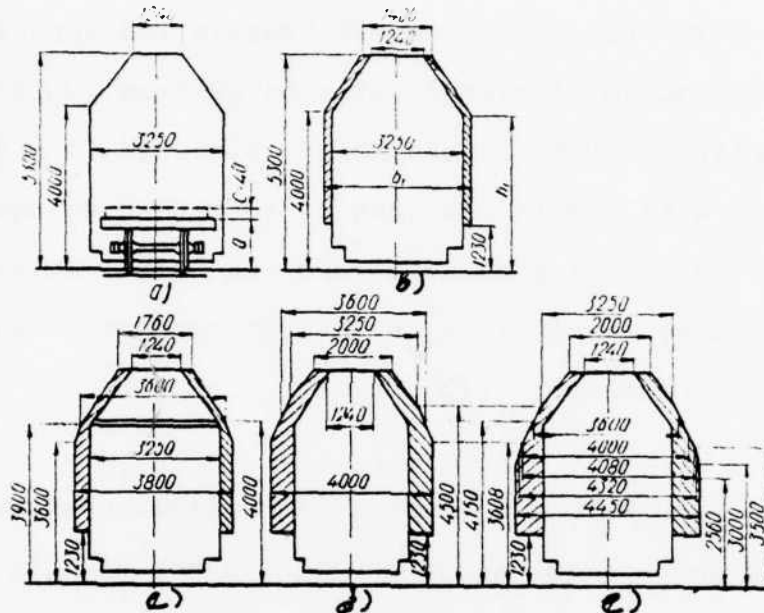


Fig. 10. Dimensions of the rolling stock of railroads; a) the dimension of the contour of loading; b) the size limitation of degrees of 0 and I; c) the same, of the II degree; d) the same, of the III degree; e) the same, of the IV degree.

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On the manufacturing plant it is necessary to assemble each part of the apparatus with the internal devices and to hydraulically test/experience with the necessary control assembly on the field joint of adjacent parts, by application control marks/scratches/grooves and with marking of parts with permanent

paint.

Vessels and apparatuses, large-sized with respect to diameter, should be delivered with the possibility of their transporting by water or highway means completely assembled, with the internal devices, rolled and tested on the stand. By railroad them they transport by the enlarged block-cylinders/reels, from prepared with the method of temporary/time deformation, by the developed institute of the electric welding im. Ye. O. Paton. The enlarged units and cylinders/reels, loose parts and assemblies of vessels and apparatuses of large-size ones according to the diameter are manufactured on technology, developed by supplier plant and matched with the assembling organization. Technology must provide for a maximally possible coarsening/consolidation of units and of loose parts of the vessels and apparatuses on the manufacturing plant, their control assembly and other operations, whose accomplishing provides the installation of the large-size vessels indicated and apparatuses without the completion of separate units, assemblies and parts on the construction site. Finish manufacture of large-size vessels and apparatuses from the enlarged units, the assemblies and the parts on the spot of building must be done by manufacturing plant. For the transportation of large-size apparatuses by railroad utilize special transporters (Fig. 11). One of the devices, intended for the transportation of large-size apparatuses along the highways,

it is shown in Fig. 12.

The forms of transport means for the transportation of apparatuses are given in Table 7.

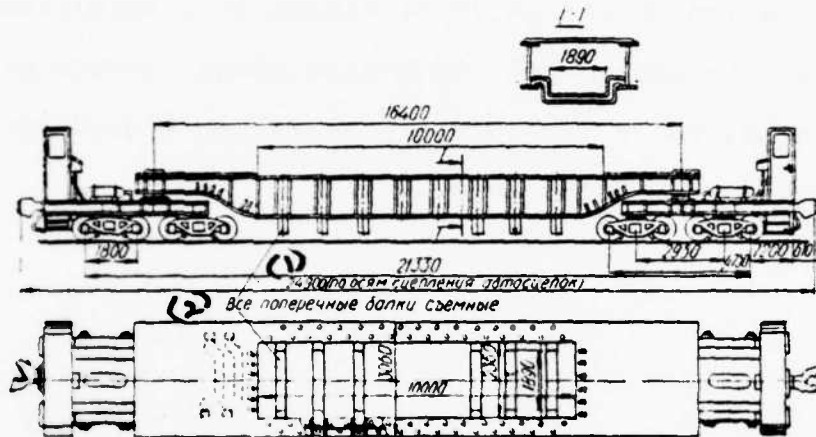


Fig. 11. Railroad transporter of well-shaped type. Key: (1).  
24900/along axles of the cohesion/coupling of automatic couplers.  
(2). all transverse beams are removable.

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The methods of loading and the calculations of fastenings of large-size apparatuses in the rail transport, on the vessels and on to float it must develop/process and match manufacturing plant together with Ministry of communications and with the Ministry of the River Fleet.

Supplies large-size apparatuses to the coast for the dispatch by water transport manufacturing plant. Large-size hoppers, boxes of condensers and other similar to construction/design large-size

equipment are supplied by the units of maximally transportable sizes/dimensions. The bottoms of large-size boxes, immersion condensers are supplied in the form of the welded ground panels, convoluted into the cylinders/reels.

Table 7. Types of conveying devices for the transportation of large-size apparatuses.

Вид транспорта (1)	(2) Максимальные габариты		
	Диаметр, мм (3)	Длина, м (4)	Вес, т (5)
(6) Железнодорожный:			
(7) платформа	3780	13	60
(8) транспортер	3780	13	90
"	3450	45	110
"	3840	34	240
"	4050	32	110
"	4232	9,8	55
(9) Автодорожный	5860	48,33	265
(10) Баржа	8000	50	(12) 400
(11) На плаву	10000	100	Не ограничен

Key (1). the form of transport. (2). maximum dimensions (3).

Diameter, mm. (4). Length, m. (5). weight, t. (6). Railroad. (7).

platform. (8). transporter. (9). Highway. (10). Barge. (11). On to

float. (12). Unconfined.

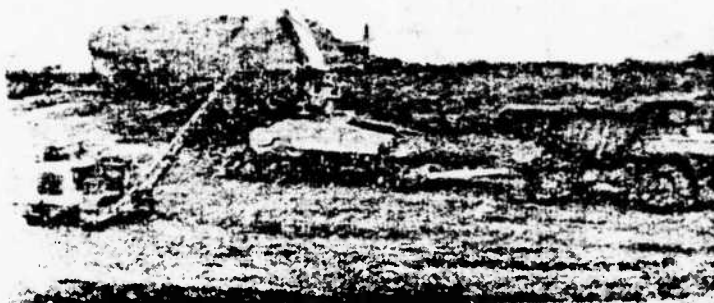


Fig. 12. Transportation of large-size apparatus along the highways.

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Into the assembly of the supplied by manufacturing plant apparatuses with the internal mechanisms of reactors, crystallizers, capacitance with the piston pumps and other devices enter: the electric motors, reducers, pumps and other equipment. Into the assembly of the supplied vessels, apparatuses and other articles they enter: one assembly of packing and reciprocal flanges with the fasteners. For the vessels and the apparatuses, made from two-ply steel, instead of the reciprocal flanges reciprocal of branch are supplied.

For the purpose of an improvement in gliding/planning production and delivery of large-size apparatuses for the chemical, petroleum

and petroleum refining industry ' the projected enterprises are obligated to provide transmission/delivery not later than 9 months prior to the beginning of the planned/glide year to Soyuzglavkomplekt [Rtsohzglavkomplekt - Main Administration for Ensuring the Supply of Complete Sets of Equipment] of Gosnab [crtgossnab - State Committee of the Council of Ministers for Materials and Equipment Supply] of the USSR orders for the manufacture and deliveries of complete/unitized large-size apparatuses with the necessary technical documentation.

FOOTNOTE ' Resolution of VSNKh of the USSR of 19 June, 1965, No 41.

ENDFOOTNOTE.

In agreements on manufacture and delivery of the large-size apparatuses, consisted by manufacturing concerns with the completing organizations and enterprise-clients, besides the conditions, provided for "Position about the deliveries of production of industrial-technical designation/purpose", must be indicated : the order of the dispatch of equipment - by separate units, by units or in the assembled form; the delivery times of units and units; the form of transportation; the order of the assembly of large-size equipment on the construction site of client by the forces of manufacturing concern; the periods of beginning and termination of assembly; the responsibility of client with respect to the guarantee

due to the means of enterprise-producer of the assembly crews of this enterprise, which work on the construction site of client, hoisting-transporting and welding facilities, by auxiliary materials, by official and everyday locations and to rendering aid to assembly crews by the isolation/liberation for them of the working corresponding specialties.

FOOTNOTE <sup>2</sup> Resolution of the council of ministers of the USSR of 22 May, 1959, No 539. ENDFOOTNOTE.

In the case if manufacturing concern enlists construction-assembly and other organizations in collaboration in the manufacture of large-size equipment, it is obligated to transfer by them in the routine on their requirement the corresponding limits by the labor/work, assignment on reduction/descent of cost of construction-assembly works, and also financial indices, if the works indicated are not provided by plan/layout. The apparatuses, which exceed in their sizes/dimensions the dimensions of loads, transportable along the railroads, outsize along the length and dispatched in connection with this in the form of units and nodes, are included in the volume of the commercial production of manufacturing concern after inspection/acceptance by the quality control department of this enterprise of the completed units and units, suitable for the welding. Welding of seams must be produced on

the construction site of client by the forces of manufacturing concern or by forces of the drawn by it in the routine construction-assembling organization.

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Payment to the costs/values of apparatuses outside along the length, manufactured and dispatched in the form assemblies and units, must be produced by client on the price list, affirmed by Gosplan of the USSR, within two periods: 93% of cost/value are paid out after the termination of dispatch by the manufacturing concern of all units and units and 7% after assembly and welding of apparatuses on the construction site of client and signing of the acceptance report/event.

The obligation of manufacturing plant for manufacture and delivery of outside according to the diameter apparatuses is considered made after delivery to their client on the construction site on the acceptance report/event. The manufactured apparatuses must be included in the volume of the commercial production of manufacturing plant only after assembly and their weldings on the construction site and delivery to client on the report/event. Payment to the costs/values of apparatuses outside for diameter, manufactured and dispatched in the form units and assemblies, must be produced by

the client of apparatuses on the price list, affirmed by Gosplan of the USSR within two periods: 75% of cost/value are paid out after the termination of dispatch by the manufacturing plant of all units and units and 25% - after assembly and welding of apparatuses on the construction site of client.

Assembling organizations are obligated to in proper time exert the necessary aid in the development/detection of the entire nomenclature of articles, placed through Glavkomplekt of Gossnab of the USSR the clients of equipment, bearing in mind that the belated order of separate constructions/designs and articles leads to the delay of building and in a number of cases to the disruption/separation of the periods of the input/introduction of object into the operation. They are obligated to examine together with the clients of condition to the delivery of the equipment, applied to the agreements, and to determine the periods of its delivery, on the basis of the duration of the equipment installation and established/installed periods of the input/introduction of objects. In this case assembling organizations must be guided by the requirements, presented in MRTU 2-04-10-63, and consider that in connection with the expansion of fleet of railroad transporters is provided the transportation in the assembled type of the apparatuses with a diameter of up to 4.25 m. On the new railroad transporters, equipped with hydraulic relief mechanisms, can be transported the

apparatuses with a weight of up to 120 t, with a length of up to 32 m with the diameter to 4 m, at the disposal of the Ministry of Railroads of the USSR are devices for the transportation of heavier apparatuses. Assembling organizations must to the operating time on finish manufacture of large-size apparatuses on the construction site allot rigging and other special equipment, which is absent in client, to client. Assembling organizations previously, with preparation/training and signing by the clients of agreements to the delivery of large-size apparatuses must refine list of equipment, isolated by them for the period of finish manufacture of these apparatuses. To exert client aid in unloading and transportation of heavy large-size apparatuses on the construction sites.

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Together with the clients to in advance study these questions, assigning in the especially complicated cases on their solution the planning and scientific research organizations of Minmontazhspetsstroy of the USSR.

During the inspection/acceptance of vessels and apparatuses into the installation assembling organizations must thoroughly check the observance of requirements for their delivery in accordance with MRTU 2-04-10-63. Accomplishing works on the finish manufacture of

apparatuses large-size according to the diameter is solved to accept only without the harm for the carrying out of basic installation works. In these cases the works indicated must be connected by client into the plan/layout of assembling organization with the transmission by it by supplier plants of the apparatuses of the corresponding limits on the labor/work and be accomplished/realized according to the direct agreement with the supplier plants of apparatuses. In this case the cost/value of the made works in accordance with the plan/layout must be considered in the volume of the made contract works. During the determination of the cost of operation from finish manufacture of equipment assembling organizations should be been guided the indications of price list No 23-03. The cost/value of finish manufacture of apparatus with the delivery of units and units in accordance with the working drawings must be defined as the difference between the cost/value of apparatus, determined according to the price list in accordance with Table 2, and of 93% cost/value of the same apparatus, determined in the price list according to Table 1.

During the inspection/acceptance of works on the assembly of the apparatuses, large-size along the length, placed in the form of two or several parts, assembling organization one should be convinced of the fulfillment by the manufacturing plant of the requirement MRTU 2-04-10-63, which foresees conducting the control assembly of the

adjacent parts of the apparatus on the manufacturing plant. Payment for the assembly of the joints of lengthy apparatuses must be produced by agreement with the manufacturing plant in accordance with the resolution by VSNKh of the USSR of 19 June, 1965, No 41. Assembling organizations must consider that the effective positions on assembly and welding of vessels large-size according to the diameter and apparatuses do not apply to large-size spherical capacitance, including electro-dehydrators, in connection with the fact that it is expedient to make directly the assembly of these capacitance from the large/coarse elements/cells of plant delivery on the foundation, combining assembly and welding of elements/cells with the installation. For the spherical capacitance the wiring cards of price list No 13 took into consideration all works on assembly and welding of spherical capacitance with a volume of 600 m<sup>3</sup> and higher, and the price list of values No 01-09 - cost/value of their blank without the assembly.

At present in price list No 23-03 it is caused, that the cost/value of the preparation of apparatuses under humification, polishing, grinding, tinplating, brass plating, zinc plating, lead plating and other protective coatings, and also the cost/value of accomplishing these coatings, except coloration, with the wholesale prices of price list are not connected. For these works the payment is produced over the wholesale prices of price list in the

sizes/dimensions, matched by supplier plant with client, by which it is confirmed that also these works on the construction site on the large-size equipment it is obligated to make plant-supplier.

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In 1968 the Gosstroy of the USSR affirmed for applying from 1 January, 1969. "general/common/total part to the price lists to the equipment installation". In this document are contained general/common/total indications for 35 price lists to all types of equipment, for all branches of industry necessary during the determination of estimated cost/value and calculations for the made works according to the equipment installation. Common part and price lists to the equipment installation are developed on the basis of the requirements of the 3rd part SNIP [Construction norms and regulations] and the effective technical specifications on delivery and equipment installation. By price lists is caused entrance of equipment into the installation by complete/unitized and that painted. The large-size equipment, which enters the installation at that dismantled/selected bide or maximally enlarged units (units), must not cause on the installation of the carrying out of adjustable operations. Equipment must be set in the installation with the reciprocal flanges on the branches, by fasteners - by connecting pins, by bolts and by the anchor bolts, which passed on

plant-producer unit-by-unit or overall assembly, also, in the necessary cases rolling, bench and other tests in accordance with the technical specifications for his manufacture and delivery, with the static and dynamic balancing/trimming of rotating parts.

The cases of the nonobservance of requirements for quality and equipment to be supplied of the large-size technological equipment by machine building industry is one of the principal reasons, which call an increase in the duration of building, its rise in price and lowering of the quality of equipment, since conditions and means for finish manufacture, adjustment and consolidation assembly of large-size equipment on the construction site by the forces of supplier plant, by assembling or another attracted organization are considerably lower than the conditions and the means of the equipped production shops of the manufacturing plants of equipment.

Experiment of building and putting into operation of contemporary large/coarse production capacities confirms the dependence of quality and equipment to be supplied of large-size technological equipment on the attention to the observance of the requirements indicated at all stages of planning, gliding/planning, manufacture and staffing of large-size technological equipment for each building.

Deliveries of equipment to the projected enterprises.

The solution of specific technical problem - putting to use of new production capacity depends on period, opportuneness of supply of material, including opportuneness of the delivery of large-size technological equipment.

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In 1965 the council of the national economy of the USSR affirmed "Basic condition/positions on staffing of the projected and reconstructed enterprises by equipment, and also about the interrelations of suppliers, clients and users of this production" <sup>1</sup>, in which were determined the periods of the termination of the delivery of equipment, fittings and parts of conduits/manifolds for building of the chemical, petrochemical, oil-refining, petroleum, gas and paper and pulp, metallurgical and coal industry (Table 8.9).

FOOTNOTE <sup>1</sup> Order SNKh of the USSR of 5 May, 1965, No 360.

ENDFOOTNOTE.

The use of the bridge cranes and other cargo-transport means, intended by project for the technological and repair needs during the operation of the projected objects, contributes to the execution of

the installation of technological equipment in short periods. In a number of cases operational taps/cranes are the most effective assembling cargo-transport means. For example, bridge cranes during the equipment installation of rolling, forge-press, machine and other shops, ore-dressing combines, compressor and pumping plants.

Bridge and other operational taps/cranes are delivered in time for 2-3 months of earlier than the periods, established/installed for the beginning of the installation of technological equipment of object.

The nonobservance of this position, as experiment is shown, constantly/invariably causes the long delay of the installation of technological equipment, since in the installation of technological equipment cargo-transport operations are numerous and are labor-consuming. During their accomplishing the bridge cranes are 2-3 times more effective than erecting cranes, which are located on the balance of assembling organizations, and in a number of cases technically it is not possible to replace bridge cranes with other taps/cranes.

The task of putting into operation of production capacity within the established/installed period must be solved properly at all stages of the design of building, gliding/planning and staffing the

deliveries of equipment for each object. It is simultaneously necessary to ensure the timely building of buildings, the installation of crane runways, trolley, electric substations, landing and operating areas/sites for putting to use of bridge cranes at the beginning of the installation of technological equipment.

The many-year practice of the installation of technological equipment of metallurgical and other enterprises showed that the use in the industrial construction of bridge cranes contributed to the success of installation and to launching/starting objects within the established/installed short periods.

The deliveries of the large-size rotary furnaces of cement works are satisfied in the conformity s by Departmental technical specifications. The all-welded hull of the rotary furnace is manufactured from many elements/cells non/without- control assembly on plant-manufacturer.

Pages 34-37. <sup>R</sup>Table 8. To period of the termination of the delivery of equipment, fittings and parts of conduits/manifolds for building of the chemical, petrochemical, oil-refining, petroleum, gas and paper and pulp industry (in the months to the established/installed period of the input/introduction of object into the operation).

(1) Оборудование	(2) Промышленность, монтаж оборудования объекта				(3) Примечание
	1	2	3	4	
				счит 12 месяцев	
(8) Подъемно-транспортное оборудование (краны, тали, балки, подъемники), используемое для монтажа технологического оборудования	6	9	12	(11) с начала монтажа работ по СНиП	
(9) Аппараты колонного типа для наружных установок:					
(10) габаритные	6	6	9	(12) 30% оборудования (полностью по блокам) в начале монтажных работ.	
(13) негабаритные (по диаметру)	6	9	9	(14) Остальные 30% оборудования равномерно по кварталам (полностью по блокам), но не позднее чем за 6 месяцев до установленного срока ввода объекта в эксплуатацию	
(15) Шаровые емкости и другие сосуды, поступающие в разобранном виде	6	9	12	(16) То же	(17) За 9 и 12 месяцев поставятся первые 4 одинаковых аппарата или агрегата. Срок поставки следующих 4 аппаратов или агрегатов снижается не более чем на 3 месяца при условии, что последний аппарат или агрегат поступит не позднее чем за 6 месяцев до срока ввода объекта в эксплуатацию
(18) Горизонтальные и вертикальные аппараты пустотелые и с простыми внутренними устройствами для наружных установок	6	6	9		
(19) Печи и сушильные агрегаты	6	9	10		(20) За 9 и 10 месяцев поставятся два аппарата, остальные не позднее чем за 6 месяцев до срока ввода в эксплуатацию
(21) Теплообменные аппараты весом до 3 т	6	6	9	(22) 30% (полностью по блокам) в начале монтажных работ. Остальные 70% оборудования равномерно по кварталам (полностью по блокам), но не позднее чем за 6 месяцев до установленного срока ввода объекта в эксплуатацию	
(23) свыше 3 т	6	6	9	(24) То же	
(25) Насосы	6	6	9	(26) То же	(27) За 9 месяцев поставятся в количестве 50% оборудования (насосного, компрессорного, лифты). Срок поставки остальных 50% агрегатов снижается не более чем на 3 месяца
(28) Компрессоры поставленные:					
(29) собранным виде	6	6	9	(29) 30% (полностью по блокам) в начале монтажных работ. Остальные 70% оборудования равномерно по кварталам (полностью по блокам), но не позднее чем за 6 месяцев до установленного срока ввода объекта в эксплуатацию	(30) За 9 месяцев поставятся в количестве 50% оборудования (насосного, компрессорного, лифты). Срок поставки остальных 50% агрегатов снижается не более чем на 3 месяца
(32) блоками	6	6	9	(31) Остальные 30% оборудования равномерно по кварталам (полностью по блокам), но не позднее чем за 6 месяцев до установленного срока ввода объекта в эксплуатацию	

Table 8. (Continued)

1	2	3	4	5	6
(30) Сосуды и аппараты устанавливаемые внутри зданий (при раздельном ведении строительных и монтажных работ)	6	9	12	(30) То же	(30) За 9 и 12 месяцев поставляется комплектно 50% оборудования (масляного компрессорного, линий). Срок поставки остальных 50% агрегатов сдвигается не более чем на 3 месяца
(32) Дробильно-размольное оборудование валками, кланьями в пр., поставленное в собранном виде (38)	6	6	9	(37) 30% (комплектно по блокам для технологических линий) к началу монтажных работ. Остальные 70% оборудования равномерно по кварталам (комплектно по блокам технологических линий), но не позднее чем за 6 месяцев до установленного срока ввода объекта в эксплуатацию	(40) За 9 месяцев поставляется первые 4 аппарата или агрегата. Срок поставки следующих 4 аппаратов сдвигается не более чем на 3 месяца при условии, что последний аппарат или агрегат поступит не позднее чем за 6 месяцев до срока ввода объекта в эксплуатацию
Блоки (41)	6	9	12	(42) За 9 и 12 месяцев поставляется первые 4 индивидуальных аппарата или агрегата. Срок поставки следующих 4 аппаратов или агрегатов сдвигается не более чем на 3 месяца при условии, что последний аппарат или агрегат поступит не позднее чем за 6 месяцев до срока ввода объектов в эксплуатацию	(42) За 9 и 12 месяцев поставляется комплектно 50% оборудования (масляного, компрессорного, линий)
(43) Транспортеры, шнеки, элеваторы	6	6	9	12	(43) За 9 и 12 месяцев поставляется комплектно 50% оборудования (масляного, компрессорного, линий)
(45) Подъемно-транспортное оборудование, не используемое на монтажных работах (47) Наставляемое оборудование	4	4	4		(46) Срок поставки остальных 50% агрегатов сдвигается не более чем на 3 месяца
(49) Арматура стальная и чугунная, детали трубопроводов (фланцы, фитинги, шпильки и др.)	6	9	12	(50) 30% к началу наладки ввезены в здание монтажных работ. Остальные 70% равномерно по кварталам, но не позднее чем за 3 месяца до срока ввода объектов в эксплуатацию	(48) За 9 месяцев поставляется комплектно 50% оборудования (масляного, компрессорного, линий). Срок поставки остальных 50% агрегатов сдвигается не более чем на 3 месяца
(52) Электрооборудование в кабельных каналах	6	9	12	(53) 30% к началу наладки ввезены в здание монтажных работ. Остальные 70% равномерно по кварталам, но не позднее чем за 3-6 месяцев до срока ввода объектов в эксплуатацию	(51) За 9 и 12 месяцев поставляется не менее 50% к началу ввода арматуры и деталей трубопроводов, остальные количество поставляется равномерно по кварталам, но не позднее чем за 6 месяцев до установленного срока ввода объекта в эксплуатацию
					(54) Поставка приборов контроля и автоматики автоматизации для контроля за работой и режимами работы оборудования за 6 месяцев, в установленном сроке поставки за 3-4 месяца до установленного срока ввода объектов в эксплуатацию
					(55) За 9 и 12 месяцев поставляется оборудование в виде комплектных, индивидуальных распределительных и преобразовательных устройств, в том числе высоковольтных кабельных сетей

Key: (1). equipment. (2). Duration of installation of equipment of object. (3). Note. (4). to 6 months. (5). to 9 months. (6). to 12 months. (7). it is more than 12 months. (8). Lifting-transporting equipment (taps/cranes, overhead-travelling crane, hoists), utilized for the installation of technological equipment (9). At the beginning of the installation of works on SNIP. (10). Column type apparatuses for the external installations. (11). overall. (12). 50% of equipment (completely/unitized on the units) at the beginning of installation works. (13). outsize (according to the diameter). (14). it is numerical on the quarters (completely/unitized on the units), but not later than in 6 months to the established/installed period of the input/introduction of object into the operation. (15). Spherical capacitance and other vessels, which enter in the dismantled/selected form. (16). The same. (17). For 9 and 12 months are supplied the first of 4 identical apparatuses or aggregates/units. The delivery time of the following 4 apparatuses or aggregates/units is shifted/sheared not more than for 3 months when the latter/last apparatus or aggregate/unit will enter not later than in 6 months to the period of the input/introduction of object into the operation. (18). Horizontal and vertical apparatuses are hollow and with the simple internal devices for the external installations/settings up. (19). Furnaces and drying aggregates/units. (20). For 9 and 10 months are supplied two aggregates/units, rest not later than in 6 months to

the period of the putting into commission. (21). Heat-exchange apparatuses by weight. (22). 30% (completely/unitized on the units) at the beginning of installation works. The rest 70% equipment uniformly on the quarters (completely/unitized on the units), but not later than in 6 months to the established/installed period of the input/introduction of object into the operation. (23). to 3 t. (24). it is more than 3 t. (25). Pumps. (26). the same. (27). In 9 months is delivered completely/unitized 50% of equipment (pumping, compressor, lines). Delivery time of remaining 50% agregatov sdvigaets4 of ne bolee cem na of 3 months. (28). Compressors supplied. (29). 30% (completely/unitized on the units) at the beginning of installation works. Rest 70% equipment uniformly on the quarters (completely/unitized on the units), but not later than in 6 months to the established/installed period of the input/introduction of object into operation by 50% (completely/unitized on the units) at the beginning of installation works. (30). In 9 months it is supplied completely/unitized by 50% of equipment (pumping, compressor, lines). The delivery time of remaining 50% of aggregates/units is shifted/sheared not more than for 3 months. (31). in the assembled form. (32). by units. (33). The rest 50% equipment are even on the quarters (completely/unitized by units), but not later than in 6 months to the established/installed period of the input/introduction of object into the operation. (34). Vessels and the apparatuses, adjusted within the buildings (during the separate conducting of

construction and installation works). (35). The same. (36). For 9 and 12 months are supplied completely/unitized by 50% of equipment (pumping, compressor, lines). Period of delivery of remaining 50% of aggregates/units it is shifted/sheared not more than for 3 months. (37). Crushing equipment rollers, calenders, etc., supplied. (38). In assembled form. (39). 30% (completely/unitized on the units for technologically the lines) at the beginning of installation works. The rest 70% of equipment uniformly on the assemblies of technological lines), but not later than in 6 months to the established period of the input/introduction of object into the operation. (40). In 9 months are delivered the first 4 apparatuses or aggregate/unit. The delivery time of the following 4 apparatuses or aggregates/units is shifted/sheared not more than for 3 months when the latter/last apparatus or aggregate/unit will enter input/introduction of object into the operation. (41). by units. (42). For 9 and 12 months are supplied the first of 4 identical apparatuses or aggregates/units. The delivery time of the following 4 apparatuses or aggregates/units is shifted/sheared not more than for 3 months when the latter/last apparatus or aggregate/unit will enter not later than in 6 months to the period of the input/introduction of objects into the operation. (43). Transporters, worm conveyors, elevators. (44). For 9 and 12 months are supplied completely/unitized by 50% of equipment (pumping, compressor, lines). (45). Lifting-transporting equipment, not utilized on the installation

works. (46). The delivery time of remaining 50% of aggregates/units is shifted/sheared not more than for 3 months. (47). Nonstandardized equipment. (48). In 9 months it is supplied completely/unitized by 50% of equipment (pumping, compressor, lines). The delivery time of remaining 50% of aggregates/units is shifted/sheared not more than for 3 months. (49). Fittings is steel and is cast iron, the part of conduits/manifolds (flanges, fittings, pin, etc.). (50). 30% of each designation at the beginning of installation works. Rest 70% are even on the quarters, but not later than in 3 months to period of introduction of objects in the operation. (51). For 9 and 12 months are supplied not less than 50% each form of fittings and parts of conduits/manifolds, a remaining quantity is supplied evenly on the quarters, but not later than in 6 months to the established/installed period of the input/introduction of object into the operation. (52). Electrical equipment and cable articles. (53). 30% of each designation at the beginning of installation works. Rest 70% are even on the quarters, but not later than in 3-5 months to the period of the input/introduction of objects into the operation. (54). The delivery of the instruments of control/check and equipment of automation for the installation on the panels and the panels must conclude in 6 months, and adjusted "on the place" for 3, 4 months to the established periods of the input/introduction of objects into the operation. (55). For 9 and 12 months are supplied equipment to the main reducing, central distributing and rotary substations, and also the high-voltage cable systems.

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Table 9. Periods of the termination of the delivery of equipment for building of metallurgical and carbon industries (in the months to the established/installed period of the input/introduction of object into the operation).

(1) Объекты и оборудование	(2) Приказом технической монтажа об- рудования	(3) Срок оконча- ния работ по оборудованию	(4) Примечание
1	2	3	4
(5) <b>Агломерационные фабрики</b>			
(4) Комплекс на 2 машины с лентами спекания 75 м <sup>2</sup>	8	6	
(7) Агломашины		6	(2) Каркас и привод аглома-
(8) Эксгаустеры		6	шины поставляются к на-
Вагоноопрокидыватели		6	чалу монтажных работ
Краны мостовые электрические грузо-		7	
подъемностью 2/3, 35/5 и 50/10 тс		9	
Краны-перегрузчики		9	
Транспортеры пластинчатые В-1200		6	
Конвейеры ленточные стационарные В-1200-1400		6	
Дробилки четырехвалковые 900×700, КДМ-1750, одновалковые 1300×2700		6	
(10) <b>Агломерационные фабрики</b>			
(4) Комплекс на 1 машину с лентами спекания 200—250/312 м <sup>2</sup>	9	6	(3)
(12) Агломашины		8	Каркас и привод аглома-
(13) Эксгаустеры		8	шины поставляются к на-
Вагоноопрокидыватели		8	чалу монтажных работ
Охлаждатели линейные		8	
Краны мостовые электрические грузо-		10	
подъемностью 30/5, 50/10 тс		10	
Краны-перегрузчики		10	
Дробилки 1300×4200		6	
Транспортеры пластинчатые В-1200, В-1400		6	
Конвейеры ленточные стационарные В-1200, В-1400		6	
(15) <b>Оборудование доменной печи объе-</b>	5	6	(2) Закладные части (холо-
мом 2000 м <sup>3</sup>			дильники) доменной печи
(17) <b>Оборудование доменной печи объе-</b>	8	6	(3) Закладные части (холо-
мом 2700 м <sup>3</sup>			дильники) доменной печи
(19) <b>Лифты</b>		6	поставляются за 11 меся-
			цев до срока ввода в дей-
			ствие объекта. Чаши
			и конусы поставляются к
			началу монтажных работ

Table 9. (Continued)

(20)	Оборудование бункерной эстакады		6
	Воздуходувки		6
	Оборудование по газоочистке		6
	Краны-перегрузчики		7
	Краны мостовые электрические грузо- подъемностью 30/5, 50/10 тс		7
(21)	Кислородно-конвертерный цех с кон- вертерами № 1 и 2 емкостью 100— 130 т каждый	8	8
	Краны мостовые электрические грузо- подъемностью 50/10, 100/20, 180/30 тс		10
	Конвертеры емкостью 100—130 т		8
	Миксеры емкостью 1300 т		8
	Известково-обжигательные печи		8
	Оборудование по газоочистке		8
(22)	Кислородный цех		
	Блок разделения воздуха типа БР-9 производительностью 12500 м <sup>3</sup> техно- логического кислорода	8	8
	Установка непрерывной разливки стали	10	8
	Краны мостовые электрические грузо- подъемностью 50/10, 100/20, тс		12
	Технологическое оборудование уста- новки непрерывной разливки стали (УНРС)		8
(23)	Мартеновский цех с печами № 1, 2 емкостью по 500—600 т каждая	7	8
	Краны мостовые электрические грузо- подъемностью: 30/5, 50/10, 100/20, 200/50, 180/30 тс		8
	Миксеры емкостью 1300 т		8
	Перекидные устройства		8
	Завалочные машины		8
(24)	Ферросплавные цехи, цехи хромис- тых рафинированных сплавов и со- ставе 6 открытых печей мощностью по 3,5 тыс. квт каждая	9	6
(25)	Электропечи мощностью 3,5 тыс. квт		9
	Разливочные машины		6
	Краны мостовые электрические грузо- подъемностью 50/5 тс		6

Table 9. (Continued)

(26)	Конвейеры ленточные стационарные В-1000, В-1200		6
(27)	Прокатные цехи		
	Слябинг 1150 мм	6	6
	Блюминг 1300 мм		6
	Краны мостовые электрические грузо- подъемностью 30/5, 50/10, 75/20, 100/20 тс		7
	Рабочие клетки слябинга 1150 мм		6
	Рабочие клетки блюминга 1300 мм		6
	Ножницы усиленные до 3000 т		6
	Рольганги		6
(28)	Непрерывно-заготовочный стан 850/700/500	8	6
	Крупносортиный стан 650		6
	Среднесортиный стан 400—450 мм		6
	Краны мостовые электрические грузо- подъемностью 50/10, 75/20 тс		9
	Линии рабочих клеток диаметром 850, 700, 450 мм		8
	Рольганги		6
	Ножницы		7
	Правильные машины		6
(29)	Станы непрерывные 350, 250 и про- волочные 250	6	6
	Краны мостовые электрические грузо- подъемностью 20/5, 30/5 тс		7
	Линии рабочих клеток		6
	Рольганги, холодильники		6
	Ножницы и правильные машины		6
(30)	Стан непрерывный 2000 мм горячей прокатки листов	12	8
	Краны мостовые электрические грузо- подъемностью 50/10, 100/20 тс		14
	Линии рабочих клеток		10
	Рольганги		7
	Ножницы		8
	Правильные машины		7
	Штабелеры		6
	Линии резки		8
(31)	Стан непрерывной холодной прокат- ки 1700 мм	8	6
	Краны мостовые электрические грузо- подъемностью 30/10, 100/20 тс		9

Table 9. (Continued)

Линии рабочих клеток		8
Рольганги		6
Ножницы		7
Правильные машины		6
Линии резки		8
(32) Стан трубозлектросварочный 159—529 мм	5—6	5
Краны мостовые электрические грузоподъемностью $30\frac{1}{2}$ тс		6
Прессы усилием 6000 т		6
Прессы-экспандеры		6
Сварочные станы		6
Рольганги		5
(33) Стан непрерывный для производства бесшовных труб диаметром 30—102 мм	12	10
Краны мостовые электрические грузоподъемностью $30\frac{1}{2}$ тс		12
Рабочие клетки		10
Холодильники		10
Рольганги		6
Ножницы		6
(34) Коксохимическое производство в составе 4 коксовых батарей по 65—77 печей емкостью одной камеры 30 м <sup>3</sup> и более		6
(35) Первая коксовая батарея	14	
1. Основное оборудование: коксовые машины вагонопрокидыватели, дробилки, грохоты, оборудование коксовых батарей, химическое оборудование		16
2. Вспомогательное оборудование: транспортеры углеподачи и коксортировки, оборудование склада угля, насосы, сантехническое оборудование и др.		10
(36) Вторая коксовая батарея	9	6
1. Основное оборудование: коксовые машины оборудование коксовых батарей		10
2. Вспомогательное оборудование: транспортеры тракта подачи угля, кокса и др.		10
		6

Table 9. (Continued)

(37) Углеобогащительные фабрики мощностью до 6 млн. т: дробилки, компрессоры, грохоты, насосы, сепараторы, обогащительное оборудование и др. транспортёры, сантехническое оборудование и др.	12	6	(38) К началу монтажа поставляется 50% оборудования
(39) Огнеупорные цехи Цех по производству шамотных изделий в составе 4 туннельных печей и прессов полусухим способом мощностью 400 тыс. т в год 1. Основное оборудование: помольное, прессовое, транспортирующее 2. Вспомогательное оборудование: затворы бункеров, дозаторы и др.	10	6	
(40) Цех по производству магнетитового порошка с 2 вращающимися печами мощностью 400 тыс. т в год 1. Основное оборудование: вращающиеся печи, дробилки, грохоты 2. Вспомогательное оборудование: транспортёры ленточные, оборудование пневмотранспорта, сантехническое и др.	8	6	
(41) Цех смолотолочитовых огнеупоров мощностью 60 тыс. т в год 1. Основное оборудование: прессы, дробилки, грохоты и др. 2. Вспомогательное оборудование: транспортирующее, сантехническое и др.	8	6	
(42) Доломито-обжигательный цех с обжигом сырья в 3 вращающихся печах мощностью 300 тыс. т в год 1. Основное оборудование: вращающиеся печи, установки для очистки газов, трубы, грохоты дробильно-сортировочного отделения 2. Вспомогательное оборудование: затворы бункеров, дозаторы, транспортёры и др.	9	6	

Table 9. (Continued)

(43) Горморудные шахты мощностью до 1 млн. т в год	15	13
Подъемные машины цилиндрические диаметром 4 м и выше		16
Многоканатные подъемные машины		16
Индивидуальное оборудование		13
(44) Обогащительные фабрики мощностью 40 млн. т в год сырой руды	11	
Обогащительное и индивидуальное оборудование		6
Краны мостовые электрические грузоподъемностью 100/30, 250/30 т		13
Дробилки КСД-1500/180		7
Мельницы шаровые и стержневые		7
Конвейеры ленточные стационарные В-2000		6
(45) Угольные шахты производительностью 0,9—3,0 млн. т в год	12	6
Подъемные машины диаметром 4 м и выше		13
Многоканатные подъемные машины		13
Вентиляторы главного проветривания ВЦД-3,3		6
Вентиляторы главного проветривания ВОКД от № 2 и выше		6
Котлы ДКВР-2,5 20/13		6
Обогащительное оборудование		10
Индивидуальное горношахтное оборудование		6

Key: (1). Objects and equipment. (2). Duration of equipment installation. (3). Periods of the termination of delivery of equipment. (4). Note. (5). Agglomerating factories. (6). Complex to 2 machines with the tapes of sintering 75 m<sup>3</sup>. (7). Sintering machines. (8). Framework/body and drive of sintering machine are delivered at the beginning of installation works. (9). Exhausters. Car dumpers. Taps/cranes are bridge electrical by load capacity 2/5, 35/5 and 50/10 t. Cranes-conveyors/reloaders. Transporters plate-type B-1200. Conveyors are the strip/tape stationary B-1200-1400. Crushers are double-roll 900×700. KDM-1750, single-roll 1300×2700. (10). Agglomerating factories. (11). Complex to 1 machine with the tapes of sintering 200-250/312 m<sup>3</sup>. (12). Sintering machines. (13). Framework/body and drive of sintering machine are delivered at the beginning of installation works. (14). Exhausters. Car dumpers. Coolants are linear. Taps/cranes are bridge electrical by load capacity 30/5, 50/10 t. Tap-conveyors/reloaders. Crushers 1300×4200. Transporters are lamellar B-1200, B-1400. Conveyors are the strip/tape stationary B-1200, B1400. (15). Equipment of blast furnace with a volume of 2000 m<sup>3</sup>. (16). The laying parts (coolers) of blast furnace are supplied in 9 months to the period of putting into operation of objective. (17). Equipment of blast furnace with a volume of 2700 m<sup>3</sup>. (18). The laying parts (coolers) of dome-shaped furnace are delivered in 11 months to the period of

input/introduction into operation of object. Cups and cones are supplied at the beginning of installation works. (19). Elevators. (20). Equipment of the stockhouse. Blowers. Equipment on the gas purification. Cranes-conveyors/reloaders. Taps/cranes are bridge electrical by load capacity 30/5, 50/10 t. (21). Oxygen-converter shop with converters No 1 and 2 with a capacitance of 100-130 t each. Taps/cranes are bridge electrical by load capacity 50/10, 100/20, 180/50 t. Converters with the capacitance of 100-130 t. Mixers with the capacitance of 1300 t. Lime kilns. Equipment on the gas purification. (22). Oxygen shop. Unit of the separation of air of the type BP-9 with a productivity of 12500 m<sup>3</sup> of technological oxygen. Installation/setting up of continuous teeming of steel. Taps/cranes are bridge electrical by load capacity 50/10, 100/20, t. Technological equipment for the installation/setting up of the continuous casting of steel (UNRS). (23). Martin Czech with furnaces No 1, 2 a with capacitance of 500-600 t each each. Taps/cranes are bridge electrical by the load capacity: 30/5, 50/10, 100/20, 300/50, 450/150 t. Mixers with the capacitance of 1300 t. Reversing devices. Charging machines. (24). iron-alloy shops, the shops of the chromium refined alloys in the composition of 6 open furnaces with power by 3.5 thousand kVA each. (25). Electric furnaces with power 3.5 of thousand kVA. Casting machines. Cranes bridge electrical by load capacity 50/5 t. (26). Conveyors are the strip/tape stationary B-1000, B-1200. (27). Rolling departments. Slabbing mill 1150 mm.

Blooming mill 1300 mm. Are torn bridge electrical with lifting capacity 30/5, 50/10, 75/20, 100/20 t. The roll stands of slabbing mill 1150 mm. The roll stands of blooming mill 1300 mm. Shears by effort/force to 3000 t. Roller conveyors/roller trains. (28). Continuous-supply mill 850/700/500. Large-size mill 650. Medium-grade mill 400-450 mm. Taps/cranes are bridge electrical by load capacity 50/10, 75/20 t. Lines of roll stands with diameter 850, 700, 450 mm. Roller conveyors/roller trains. Shears. dressing machines. (29). Mills continuous 350, 250 and wire 250. Taps/cranes are bridge electrical by load capacity 20/5, 30/5 t. Lines of roll stands. Roller conveyors/roller trains, coolers. Shears and dressing machines. (30) mill continuous 2000 mm of the hot rolling of sheets. Kahns are bridge electrical by load capacity 50/10, 100/20 t. Lines of roll stands. Roller conveyors/roller trains. Shears. dressing machines. Stackers. Lines are sharp. (31). Mill of continuous cold rolling 1700 mm. Taps/cranes are bridge electrical by load capacity 50/10, 100/20 t. Lines of roll stands. Roller conveyors/roller trains. Shears. dressing machines. Lines are sharp. (32). Mill electric pipe-welding 159-529 mm. Taps/cranes are bridge electrical by load capacity 30/5 t. Presses by effort/force 6000 t. Press-expanders. Welding mills. Roller conveyers. (33). Mill is continuous for the production of the seamless pipes with a diameter of 30-102 mm. Taps/cranes are bridge electrical by load capacity 30/5 t. Roll stands. Coolers. Roller conveyors/roller trains. Shears.

(34). By-product coke industry in the composition of 4 battery of coke ovens by 65-77 furnaces with a capacitance of one chamber/camera of 30 m<sup>3</sup> and more. (35). First battery of coke ovens. 1. The basic equipment: the coke machines, car dumpers crusher, crashes/gratings the equipment of coke batteries, chemical equipment. 2. Auxiliary equipment: transporters of the coal feed and coke sorting, equipment of the storage of carbon/coal, pumps, sanitary-engineering equipment, etc. (36). Second battery of coke ovens. 1. The basic equipment: coke machines the equipment of the coke batteries. 2. The auxiliary equipment: transporters of the channel of the supply of carbon/coal of coke, etc. (37). Coal-concentrating factories with power to 6 mln. t: crusher, compressors, crashes/gratings, pumps, separators, concentrating equipment, etc. transporters, sanitary-engineering equipment, etc. (38). At the beginning of installation it is supplied by 50% of equipment. (39). Refractory shops. Shop for the production of fireclay articles in the composition of 4 tunnel kilns and presses in a semi-arid manner with the power of 400 thousand t per annum. 1. The basic equipment: grinding, press, that transports. 2. The auxiliary equipment: the gates/shutters of hoppers, batchers, etc. (40). Shop for the production of magnesite powder with 2 rotating by the furnaces by power 400 thousand t per annum. 1. The basic equipment: the rotary furnaces, crushers, crashes/gratings. 2. The auxiliary equipment: transporters strip/tape, the equipment of airslide, sanitary-engineering, etc. (41). Shop of tar-bonded

dolomite refractories with the power of 60 thousand t per annum. 1. The basic equipment: presses, crushers, crashes/gratings, etc. 2. The auxiliary equipment: transporting, sanitary-engineering, etc. (42). Dolomite-burning shop with the firing of raw material in 3 rotary furnaces with a power of 300 thousand t per annum 1. The basic equipment: the rotary furnaces, installations/settings up for the scrubbing of gas, ducts/tubes/pipes, crashes/gratings of crushing-sorting department/separation. 2. The auxiliary equipment: the gates/shutters of hoppers, batchers, transporters, etc. (43). Mining mines/shafts with power to 1 mln. t per annum. Hoisting machines cylindrical with diameter 4 m and above. Multirope hoisting machines. Individual equipment. (44). Concentrating plants with the power of 4.0 mln. t per annum of damp/raw ore. Enriching and individual equipment. Taps/cranes are bridge electrical by load capacity 100/20, 250/30 t. Crushers KCD-1500/180. Mills spherical and rod. Conveyors are the strip/tape stationary B-2000. (45). Carbon mines/shafts with the productivity of 0.9-3.0 mln. t per annum. The hoisting machines with a diameter of 4 m are above. Multirope hoisting machines. Fans of main aeration ВЦД-3.3. The fans of main aeration VOKD from No 2 are above. Boilers ДКБП-2.5 20/13. Concentrating equipment. Individual mining equipment.

For the consolidation assembly, the adjustment of joints and welding of elements/cells into the shells and the units various agreement is

concluded. Consolidation assembly is fulfilled on the diagram, comprised by supplier plant. Assembling organizations additionally enlarge the fine/small units of furnace body into the larger/coarser units to 120 or 140 t in connection with the load capacity of the available assembling gantry cranes.

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Additional consolidation assembly during building of fine/small units into the large/coarse assembling units and according to other types of large-size technological equipment is fulfilled in accordance with point/item 13 of "general/common/total part to the price lists to the equipment installation", according to which in the values of the installation the expenditures for the consolidation assembly of the equipment, supplied by units for conducting the installation by maximally enlarged units in the limits of the action of cargo means are considered.

For guaranteeing the higher degree of the readiness of equipment point/item 10 of "common part for the price lists to the equipment installation" it provides that the equipment enters installation completely/unitized and to those painted: overall - in the completely assembled form with the protective coating, on the constant packing; outsize - in the dismantled/selected form or by maximally enlarged

units (units), which do not require during the installation of adjustable operations, with the reciprocal flanges on the branches, or by fasteners and by the anchor bolts, which passed on the manufacturing plant unit-by-unit or overall assembly, also, in the necessary cases rolling, bench and other tests in accordance with the technical specifications for its manufacture and delivery with the static and dynamic balancing/trimming of rotating parts.

Delivery specifications and equipment installation by foreign firms.

Delivery specifications of imported large-size technological equipment are determined in agreement-contracts, consisted by the foreign trade unifications of the Ministry of Foreign Trade in the USSR with the foreign firms - the suppliers of equipment.

Agreement-contracts consist to the deliveries of the complete/unitized equipment for the specific production with the adjustment of equipment for achievement of design capacity. The imported, as our export deliveries of equipment, are characterized by the increased quality of manufacture, by control assembly and bench test on manufacturing plants, and in the equipment installation during the building - by collaboration of the specialists of firm and supplier plants. Collaboration in the installation of the specialists of supplier is specified on the various agreements, which take shape

by sides not later than 6 months prior to the beginning of equipment installation. Presence during building of the specialists of supplier prior to the beginning of equipment installation is the necessary condition of agreement. Opening on the storage of client of the packed into the boxes equipment, and also the consolidation preassembly assembly of elements/cells, parts, assemblies and units of large-size technological equipment without the collaboration of the representative of supplier removes/takes responsibility from the supplier for the possible ones: incompleteness, damage or defects/flaws, discovered during the manufacture, mothballing, to the transportation of equipment.

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In such cases, when during the building there are no representatives of supplier, client cannot design corresponding report/event to the elimination of the discovered defects/flaws in the delivery of equipment, since according to agreement-contract conditions this report/event is comprised in the presence of the representative of supplier in the process of flaw detection and signs by it. Only in this case report/event is juridical base/root for the payment by the supplier of the carried by client additional expenditures.

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INSTALLATION OF LARGE-SIZE TECHNOLOGICAL EQUIPMENT  
(SELECTED PAGES)(U) FOREIGN TECHNOLOGY DIV

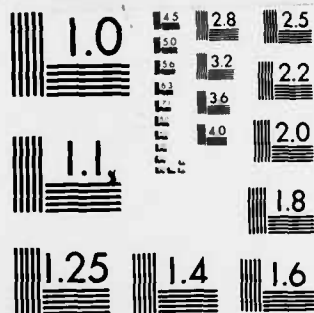
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MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS-1963-A

In the practice of the imported deliveries of large-size technological equipment is not excluded the inspection/acceptance of equipment by client directly on the manufacturing plants of supplying firm, in the process of his control assembly and bench test. In such cases the required quality of delivery is confirmed by specialists - the representatives of client in the appropriate reports/events of delivery-inspection/acceptance of equipment to his shipment into the Soviet Union.

Knowing the contractual conditions of inspecting/accepting the equipment by client on the supplier plants to the shipment of equipment in the USSR, the leader of assembling organization contributes to the acceleration of preassembly consolidation assembly and testing of the delivery of the entered for the building imported large-size technological equipment to the completeness of elements/cells, parts and assemblies and especially in accordance with commutation and electronics in the contemporary units of automatic control. The absence to the adjustment of the representatives of supplier in this case does not have a value. The careful study of the entered with the equipment technical documentation - erection drawings and of commands, and also the visual inspection of equipment they make it possible for assembling organization to develop technology of installation and adjustment of large-size equipment sometimes better than recommend the specialists

of supplying firm, and the recommending of to the foreign trade unification of the Ministry of Foreign Trade in the USSR other conditions up to the failure of head of assembly, i.e., from the collaboration of the specialists of supplier in the installation, the adjustment of equipment both in the idle and in the test complex launching/starting under the load, and also in the period of test operation and adjustment of the output of the required quality.

Specifically, busbar/tire plant with the complete/unitized imported equipment so in 1959-1961 in Dnepropetrovsk was constructed.

The installation of technological, transport, electrical equipment and automation was accomplished/realized without the representatives of supplier. They were invited when the first production was obtained and shortcomings in construction/design and manufacture of complicated and diverse equipment were completely revealed in the process of installation, adjustment and test operation.

As a result Dnepropetrovsk busbar/tire plant began the issue of busbars/tires for 4 months of earlier than its presentation to the inspection/acceptance in the constant operation.

Plant was put into use before the appointed time for the month

and accepted by state board with the distinct evaluation of the made construction and installation works.

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Before the construction of foundations under the equipment during the long time the tedious highly skilled testing of connection diagrams, testing parts and instruments of electronics of automatic control were produced. Work was organized in building of storage, equipped with special starting installation/setting up and measuring equipment. Simultaneously scheme of the replacement of imported parts in the absence of spare ones by Soviet ones so that their output/yield from the system during the operation would not stop the effective aggregates/units.

The installation of large-size technological equipment, for example, of a large quantity of shaper-vulcanizers, accomplished/realized 24-hour on the specially developed flow chart, which foresees the unpacking of equipment on the storage, its supply from the storage to place of installation/setting up on the trailers on the circular route and installation, as a result of which a quantity of the adjustable and passed/returned under the dressing by concrete aggregates/units with a weight of 26 t each reached 22 units in a 24 hour period. To the mountings of aggregates/units and the

foundations axial risks preliminarily were applied. The high-altitude mark of foundations on the preliminarily advanced assembling backings/blocks thoroughly was checked. Thus, the position of aggregate/unit during the dropping to the foundation immediately corresponded to design requirements. The bases/roots of the mountings of aggregates/units poured by concrete under the control of erectors. Around the established/installed aggregates/units the works on the device of pure/clean floors/sides immediately were fulfilled. And immediately began testing and adjustment of mechanical and electrics of the aggregates/units on temporary/time system of power supply. On the fixed aggregates/units the instruments of automation shielded by temporary/time packing.

This principle in the organization of preassembly, installation and setting up and initial operation works, widely realized according to all types of the complicated technological equipment for the first time set in the USSR and systems of overhead transport conveyors, ensured the accelerated installation of technological conduits/manifolds, completing fine/small equipment, busbars, general/common/total finishing of multispan main housing with an area of 84000 m<sup>2</sup> and approached complex testing and adjustment of technological lines and shops under the load in the test operation.

Experiment of the installation of complete/unitized imported

large-size technological equipment for large/coarse productions, delivered from the different countries, convinces, that to the inspection/acceptance of equipment by Soviet representatives on the manufacturing plants abroad it is necessary to draw experienced specialist-erectors and setup men from the assembling and setting up and initial operation organizations, which must accomplish installation and the adjustment of the accepted by them equipment.

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